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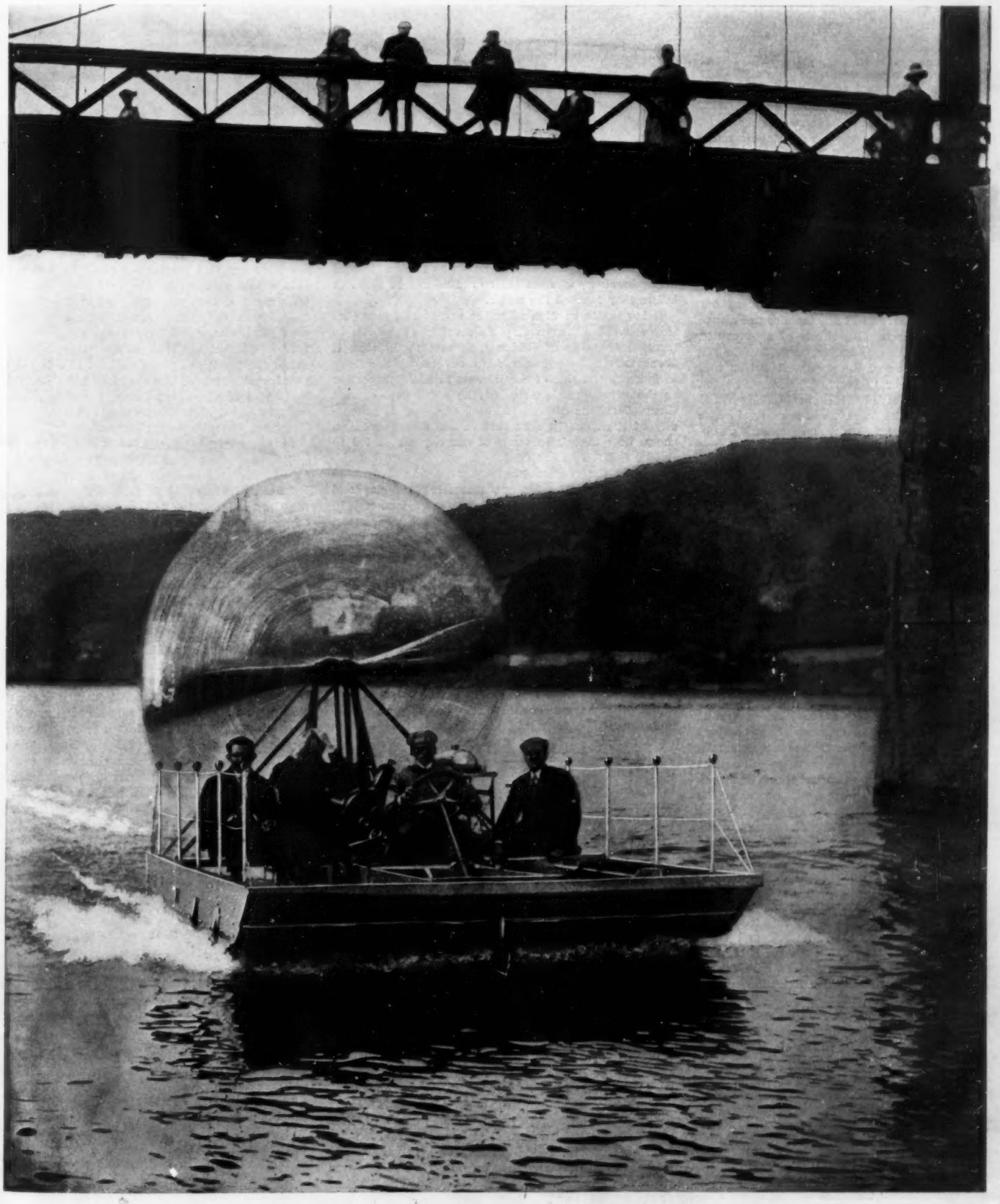

THE LAMBERT-TISSANDIER AIR-PROPELLED BOAT, CREDITED WITH MORE THAN FIFTY MILES PER HOUR.—[See page 140.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

The Speed Factor in Collisions

HOW many of the millions of people who sit at the steering wheel of their automobile realize how greatly the smashing effects of a collision are increased by an increase of the speed? Those who have been through a smash—and survived—have a more or less intelligent appreciation of this relationship. It would be interesting to learn how many out of every one hundred drivers of automobiles are aware of the fact that the destructive effects of an overturn or a collision are increased, not in proportion to the speed, but to the square of the speed. A driver who has touched the curb or "side-wiped" a fence at ten miles an hour and escaped with unexpectedly small injury, is surprised at the damage which ensues in case of a collision at 20 miles an hour, and perfectly dumbfounded—should he survive the disaster—at the havoc wrought when the speed is thirty or forty miles an hour. If he were conscious of the fact that the smashing energy embodied in his machine was four times as great at twenty miles an hour as at ten, nine times as great at thirty miles an hour, and sixteen times as great at forty, he might still contemplate the wreckage with dismay, but not with astonishment. The moral of this as applied to the automobilist is, that an increase in his speed is a most imperative call upon him for an increase of vigilance and caution, for a nicer judgment of speed and distance, and for the possession of a steady nerve and quick wit—and woe betide him in an emergency if he have not the last-named!

So also, in the larger field of railroading, the same laws exact their heavy toll with the same remorseless precision. Broadly speaking, we might say that, not alone in the destructive effects of collision—should it come—but with regard to every element, mechanical and human, that enters into the question of safe railroading, the risk and damage increase as the square of the velocity. Thus, if we raise the speed of an express train from sixty to eighty miles an hour, the momentum of the train will be nearly doubled, and practically doubled also will be the amount of crushing and rending which will take place, let us say, in the forward part of the train itself or in the after part, in the case of a rear collision, of the train into which it runs, before the energy of the moving train has been expended, and it comes to a state of rest. Furthermore, the higher speed imposes a much higher stress both upon the train itself and upon the track and track structures over which it runs. The distances between signals must be greatly increased, since with brakes of the same efficiency it would take a much longer time to slow down the faster train.

Mr. Westinghouse, speaking upon this subject, has recently stated that when emergency brakes are set on a train which is running at the rate of 80 miles an hour, the train will be still running at 60 miles an hour when it has advanced 1,100 feet from the point of application of the brakes; whereas a train would be stopped altogether in 1,100 feet if its speed were only 60 miles an hour.

Bigger Lifeboats for Ocean Liners

THE loss of the "Titanic" led to the formation of several important committees which were instructed to investigate the disaster and make suggestions designed to promote the construction of safer ships, better methods of lifeboat construction and stowage, and a general all-around improvement in the conditions affecting safety at sea. Of these committees, one of the most important was that appointed in Great Britain on Boats and Davits, whose report, recently made public, is a most valuable addition to the literature on the subject, abounding as it does in suggestions which are at once conservative and practical.

By far the most notable suggestion—one that is so sensible, we had almost said obvious, that the wonder is that it was not made long ago—is that the size of lifeboats shall be very greatly increased. The committee proposes a type that shall be of seaworthy size, weigh 28 tons, and shall provide accommodation for no less than 250 passengers. They will be decked over throughout the greater part of their length, and they will be driven by gasoline engines of sufficient power to give them a fair speed.

The question naturally arises as to how boats weighing nearly 30 tons apiece are to be launched; and the committee suggests two alternative methods. They believe that davits can be designed capable of being worked either by hand or by power, which would easily handle boats of this size; but they consider that in some cases a better plan would be to permit the lifeboat to float off as the ship goes down. Of the two methods, we think that there is no question that the former is preferable. It should not be a difficult matter to design davits and gear, compact and equally controlled, which would lower a 28-ton boat into the water with the same dispatch and certainty with which the present 5-ton boats are launched. On the other hand, there would be many risks inseparable from the plan of allowing the boat to float off from the ship as she foundered. Should the vessel go down on a fairly even keel and unencumbered by floating wreckage and gear, the lifeboat might float away without entanglement or damage; but in the event of a ship going down by the head at such extreme angles as were assumed by the "Titanic," lifeboats as heavy as those suggested might break away from their cradles and be stove in before they reached the water.

It is easy to be wise after the event; and now that this committee has made this sensible suggestion to increase the size of lifeboats, it seems odd that it should never have occurred to our naval architects to increase the size of the lifeboat in some proportion to the ever-increasing size of the ships that carried them. The fact that the lifeboat of to-day is practically of the same type as that in use fifty years ago, shows how that false sense of security which led to the loss of the "Titanic," has caused the naval architects and the shipowners to pay scant attention to the lifeboat itself. Beyond increasing its size and bettering its construction, little has been done toward its improvement—it remains to-day the same clumsy, hand-propelled craft that has littered the upper decks of our passenger ships from time immemorial.

The best lifeboat is the ship itself; and it is encouraging to note that this is the conviction which seems to prevail in all the technical discussion which followed the disaster of last year. A safe ship needs no lifeboat, and the long line of these craft, lining for hundreds of feet the upper deck of our great passenger steamers, is in itself a confession of failure—a tacit admission by the shipowner and by the Government that makes the laws regulating shipping matters, that although we have succeeded in making our ships large and fast and comfortable, we have not succeeded in making them absolutely safe. The very latest and largest transatlantic liners, such as the "Mauretania," the "Imperator," and the remodeled "Olympic," have been built with a special view to security against foundering. Theoretically, thoroughly subdivided and carefully navigated ships need no multiplicity of lifeboats; if they are to be carried, it is obvious that the 28-ton boat as proposed by the Boats and Davits Committee, represents the proper type. The largest of the ocean liners carries over eighty boats of the present type, collapsible and otherwise. They are an abominable nuisance to everyone concerned, and take up much room that could be used to great advantage for the benefit of the passengers. By adopting the 250-passenger capacity boat suggested, eighteen to twenty lifeboats fifty feet in length would take the place of the eighty or more in a ship of the largest size. The gain in safety and comfort by the use of such large boats, would be immense. They would be thoroughly seaworthy, and being power-propelled, they would be able to make port, or at least steer for the location of the nearest ship as indicated by wireless telegraphy.

The recommendation of the committee that if smaller boats of the size now in use are placed on board, they should be nested in parallel tiers with provision for launching on either side of the vessel, is particularly interesting to the SCIENTIFIC AMERICAN, since this was the plan which we suggested and illustrated at the time of the loss of the "Titanic."

Ancient and Modern Research of the Blood

THE intimate connection of the blood with life processes must early have been forced upon the notice of man. From the very first he was accustomed to associate the crimson stain with battle and death; but the true significance of the blood for vital processes has become known to us gradually by a long evolution of scientific observation, the first records of which date back at least as far as 300 B. C., when Erasistratos gave the first intimation, somewhat vague perhaps, of the circulation of the blood. The distinction between arteries and veins, familiar to-day to every school boy, was first made by Galenus, A. D. 169. It is commonly supposed that to Harvey (1628) belongs the credit of having discovered the circulation of the blood; but as an actual fact, aside from the somewhat vague indications given by Erasistratos as mentioned above, several other observers before Harvey noted the phenomenon, among them Luzzi (1315), Serveto (1540), and Colombo (1559). This does not of course in any way detract from the high value of Harvey's observations.

But the circulation of the blood is after all a mere mechanical phenomenon, comparatively obvious in character, so much so in fact that we are somewhat surprised that it should have so long escaped notice. Much less obvious, though of the highest importance, are the chemical processes in which the blood is involved, and yet the understanding of these began at a time when the science of chemistry itself was still rather rudimentary. Thus, for instance, it was pointed out as early as 1669 by Richard Lower that arterial blood owes its rich red color to the action of the air, or as we now should say, to oxidation. In the same year John Mayow showed experimentally that in respiration, just as in combustion, a constituent of the air is absorbed. That the heat of the body is due to this process was rightly discerned in 1671 by Thomas Willis. Similar observations were made in 1680 by Robert Boyle, while the discovery that respiration produces carbon dioxide as a waste product, is due to Joseph Black (1757). With the field thus prepared for him, Lavoisier had no difficulty in fully appreciating the significance of the then newly-discovered oxygen for respiration, and in 1777 he pointed out that oxygen is the only constituent of the air which plays a direct rôle in respiration. The investigation of the chemical nature of the blood itself was necessarily reserved for a somewhat later date, involving as it does, organic chemistry. In fact, it cannot be said that all questions relating to the chemistry of the blood are at the present day completely solved. Much work of the highest value in this field has been done in our own country by Prof. E. T. Reichert, who has laid down in a memoir published by the Carnegie Institution the results of his researches on the crystallography of hemoglobins. The differentiation of human blood stains from those of animal origin, has received considerable attention on account of the legal importance attached to such tests in the prosecution of criminal cases, but the methods of examination advised by Prof. Reichert far exceed in their capabilities such comparatively crude methods of differentiation, for by their means it is possible to establish the relationships of different species of animals. An article in this week's SUPPLEMENT gives a detailed, illustrated account of this development.

While the blood has a definite and important function to fulfill in health, this does not exhaust the programme of its vital activities. For it is largely owing to special processes initiated in the blood that we are able to ward off or overcome attacks of various diseases. This is achieved partly through the formation of so-called anti-bodies in the blood and partly through a literal devouring of the disease germs by the amœboid white corpuscles of the blood. Unfortunately the victory does not always lie with the defending forces of the body, and the so-called blood parasites represent a formidable army of enemies, among whom some of the most deadly are the germ of the sleeping sickness and that of malarial fever, both introduced into the body by the bite of insects. Much work has been done in recent years, and be it gratefully acknowledged, successful work, in the study and subjugation of these invisible foes.

A review of recent progress in this field, by H. G. Plimmer, will appear in next week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

Powerful Radio-station at Panama.—The Navy will shortly begin to construct a large naval radio station at Caimeto, which will be known as the Darien Radio Station. It will be of the same power as the Arlington Station near Washington, but all three of the towers will be 600 feet in height, as against 600 for one tower at Arlington and 450 feet for the other two. The bases of the towers will be 180 feet above sea level, and they will be arranged in a triangle measuring 900 feet on each side. The sending and receiving radius will be about 3,000 miles direct reach, to the Arlington Station, to San Francisco, and to Valdivia, 420 miles south of Valparaiso, on the Pacific, and Buenos Ayres on the Atlantic. It would cover a vessel anywhere on the east coast of the United States, and communicate with St. Vincent, 500 miles west of the coast of Africa. For sending, the Poulsen wireless apparatus will be used.

Engineering

American Labor More Efficient Than British.—According to a report issued by the American Bureau of Foreign and Domestic Commerce, based upon a study of seventeen industries in the United States and Great Britain, it requires 18 per cent more power and two and one half times more labor to do the same work, in the industries examined, in Great Britain than it does in the United States. Herein can be found one of the fundamental causes of the difference between wages here and in the older countries.

Draw-bridges for Escape from Fire.—A correspondent at Haverhill, Mass., suggests that as an auxiliary means of escape from the roofs of buildings or from the various floors, it might be possible to construct light iron draw-bridges, which could be let down to afford the inmates passage across alleyways and other openings of not too great width. There is something in this proposal; and conditions are conceivable in which it might be built inexpensively and used to good advantage.

Cast Copper in Place of Forged.—According to a paper recently read before the American Institute of Metals, it is now possible to produce cast copper of high electrical conductivity that is mechanically sound. The difficulties of copper casting are due to oxygen, nitrogen and oxygen-containing gases, and this is overcome by using boron, which has a high affinity for these gases, but no affinity for copper. Cast copper is rapidly replacing forged copper in many of the electrical arts.

Exploding Mines by Wireless.—An Italian engineer, Uliyi by name, is reported to have devised a method of exploding sub-marine mines at a distance of several miles by means of wireless impulses. According to the dispatch, Major Ferrie, head of the Eiffel Tower Wireless Telegraph Station, was present at an experiment in which Uliyi succeeded in exploding mines at a distance of 15 miles. Although it is true the application of wireless to warfare of this kind has been made the subject of much serious experimental work, we confess to considerable skepticism as to the results obtained.

Paper and Wood Pulp Statistics.—In the year 1909 seven hundred and seventy-seven establishments were engaged in the United States in the manufacture of paper from wood pulp. These gave employment to an average of 81,473 persons and paid $50,314,643 in salaries and wages. The cost of materials used was $165,442,341, and the value added by manufacture was $102,314,623. The growth of the industry has been phenomenal, the increase in the decade 1899 to 1909 in the value of product being $114,330,802 or 110.2 per cent.

Carrying 3,127,000,000 Passengers a Year.—The Board of Trade statistics show that during the year 1912 the trolley lines of Great Britain carried over three billion passengers. Figures such as this give an impressive sense of the magnitude of modern railway facilities, and the statistics are the more remarkable when we remember that this traffic was carried on 2,642 miles of track and in less than 13,000 cars. Significant, also, is the fact that whereas in 1900 there were 37,000 horses employed in hauling street cars, in 1912 there were only 1,500.

The Opening of Another Tunnel Beneath the East River.—The Public Service Commission has approved an agreement with the Interborough Rapid Transit Company for the reconstruction and temporary operation of what is known as the Steinway Tunnel, which crosses beneath the East River from 42nd Street, Manhattan, to Long Island City. Built several years ago, at a cost of $10,000,000, the owners agreed to have the tunnel transferred to the city of New York for $3,000,000 in consideration of its lease from the city for operation in connection with the rest of the new subway system. The tunnel is to be extended in Manhattan to Times Square and on the Long Island side to the Queensboro Bridge Plaza.

A Mile-long Bridge Rebuilt in Twelve Days.—Some feats of extraordinarily rapid construction have been performed, at times, in the history of American railroading; but we do not know of anything to surpass the feat achieved jointly by the Pennsylvania and Lehigh Valley railroads in the rebuilding of over a mile of two-track railroad bridge across Newark Bay, which was burned the night of June 14th. The bridge, 5,663 feet long, included a draw 264 feet long. In the reconstruction, each road built one track, the Lehigh Valley bridge force starting from the west end of the bridge, and the Pennsylvania gangs working from the opposite end. The fire was yet in progress when the reconstruction was decided upon and the plans got ready. Orders were given for fourteen pile drivers, thirteen marine derricks, twenty-one scows, two tugs, six catamarans, five air compressors, three water-boats, two derrick cars, two locomotive trains, three switch engines, two teams of horses, three million feet of lumber and for the assembling of 1,500 men. The work was completed in twelve days.

Science

Solvay's Generosity.—The next meeting of the International Association of Chemical Societies will be held in Brussels, beginning September 19th, 1913. Ernest Solvay, of Brussels, will place at the disposal of the International Association the sum of nearly one million francs for the purposes of the Association, together with rooms in his Institute. Consequently, it was suggested that the September meeting be held in Brussels instead of London, as a mark of appreciation of Solvay's generosity.

The Coal Resources of the World are the subject of a 1,200-page monograph in course of publication by the executive committee of the Twelfth International Congress of Geology, under the editorship of Messrs. Wm. McInnes and D. B. Dowling. An atlas of about 70 colored maps, 14x20 inches in size, will accompany the work, and about 120 maps will be scattered through the text volume. This publication will represent the results of the most thorough investigation ever made of the distribution of any mineral except iron, which was the subject of an investigation carried out under similar auspices three years ago.

American School of Archæology in China.—A committee has been appointed by the Council of the Archæological Institute of America to investigate and report on the plan of establishing an American school of archæology in China; its objects being: (1) To prosecute archæological research in eastern Asia; (2) to afford opportunity and facilities for investigation in Asiatic archæology; and (3) to preserve objects of archæological and cultural interest in museums in the countries to which they pertain, in co-operation with existing organizations for a kindred purpose, such as the China Monuments Society, organized by Mr. Frederick McCormick in 1908 at Peking.

The Reflecting Telescope.—In the SCIENTIFIC AMERICAN of July 12th, 1913, there was published an article on the reflecting telescope, by Edward A. Fath, director of the Smith Observatory at Beloit, Wis. Such a large number of inquiries have been received, both by Mr. Fath and ourselves, asking for further information regarding this type of telescope, that we desire to call attention to Nos. 1512 to 1517, inclusive, of the SCIENTIFIC AMERICAN SUPPLEMENT, in which was published a series of six articles by G. W. Ritchey on "The Modern Reflecting Telescope and the Making and Testing of Optical Mirrors." These articles treat the subject in detail and give much valuable information.

Blood and the Conservation of Energy.—While the study of the blood is essentially a matter of biological interest, it is a somewhat remarkable fact that it also furnished the clue to Julius Robert Mayer for his discovery of that fundamental law of physics, the law of conservation of energy. Mayer observed, while traveling as a ship's surgeon in the tropics, that the venous blood of his patients (in the days when blood-letting was still in general vogue) was very appreciably brighter in color than in ordinary practice in the temperate zones. From this he rightly concluded that there was a definite relation between the chemical action going on in the blood and the amount of work or heat furnished by the body, and thus following up his argument point by point, he was finally led to the conclusion that the total amount of energy of a given system is constant, that energy can neither be created nor destroyed, but only converted from one form into another.

A Urique Climatic Observatory is maintained at Davos, Switzerland, by Dr. C. Dorno, who has recently published the results of the first three years' work at this institution. Dorno's observatory is remarkable for the fact that it is securing records of many important but hitherto neglected factors in climate; it contrasts, for example, in a striking manner with the conventional meteorological station maintained by the Davos Kurverein. Special attention is devoted to the measurement of radiation, including separate records of the thermal, luminous, photographic and photo-electric intensity of direct radiation from the sun; also the combined radiation from sun and sky, with and without clouds, and the like. Already some interesting discoveries have been made as to the composition of the famous Davos sunshine, and its fluctuations with hour and season; facts that have important therapeutic applications. The most intense ultra-violet radiation occurs in summer, and this, it is suggested, explains why the invalids at Davos suffer with "glacier-burn" at that season. A single summer day may give as much ultra-violet radiation as a whole month in winter. On the other hand, the thermal radiation is most intense in the spring. Elaborate observations of atmospheric electricity are also carried on in accordance with multifarious methods developed mainly during the past decade. Benndorf electrometers are used to secure continuous registration. In its remarkable equipment and methods this institution may be said to be a generation in advance of the ordinary meteorological observatories of the world—in which respect it may be classed with the observatory of the Ebro, in Spain, a notice of which was published in the SCIENTIFIC AMERICAN of October 15th, 1910.

Aeronautics

Dunne's Self-balancing Aeroplane in a Channel Flight.—In a self-balancing Dunne aeroplane, Jules Felix flew last week from East-Church to Boulogne, France. Felix declares that Dunne has solved the problem of automatic stability and has produced a machine that needs only to be steered. He predicts that eventually no other type of aeroplane will be used. The new machine is shaped like a letter V and has no tail.

Heavy Losses in the Zeppelin Company.—In the financial report of the company which constructs the Zeppelin airships, it is shown that during the fiscal year just closed there has been a loss of $375,000, or practically half of the working capital. Inasmuch as large sums have been received from the German government for experimental purposes, and also considering the fact that the price of the vessels has been doubled during the past two years, having increased from $125,000 to $250,000, this loss seems excessive. This can be accounted for, however, by the high cost of experiment and on account of the fact that no absolute standard model has been adhered to, although all the Zeppelins have been outwardly similar in appearance.

A New Height Record.—The breaking of world's records in almost any sport has become so common that it often fails to attract the deserved amount of attention. The latest height record for an aeroplane, for this reason, has gone almost unheralded, and few besides those actually interested in flying realize or appreciate the accomplishment of Harry G. Hawker, who, on June 16th at Brooklands, set a new British altitude record for pilot and passenger by rising 13,400 feet, a distance equal to more than two and a half miles. He used an 80 horse-power Sopwith tractor biplane fitted with balanced ailerons. On the same day he also broke the British record for an altitude flight by rising with two passengers to a height of 10,800 feet.

First Air Collision Case Settled.—After a litigation of nearly three years the action between M. Thomas and Capt. Dickson, as a result of a collision between their aeroplanes while flying at the Milan meet in 1910, has at last been settled. It was recently decided that Dickson was responsible for the accident, and he was accordingly directed to pay $1,000 damages to Thomas and $2,000 to the manufacturers of the Antoinette aeroplane which Thomas was flying at the time of the accident, besides being ordered to pay four fifths of the cost of the suit. In the original bill of complaint Thomas had asked for $16,000 damages, while Dickson had put in a counter claim for $20,000 for injuries and for the destruction of his Farman aeroplane.

The New French Military Aero Stations.—The first of the military aeroplane stations built with the funds raised by national subscription in France has just been completed at Evereux, and it contains a model hangar with annexes such as repair shop and the like, also a telephone post. This station is the first one of fifty-three aeroplane stations which are to be completed by next October, and in three months it is stated that there will not be a single point in the triangle extending from Paris to the east frontier where an aviator will be more than 25 miles from a well-organized landing station. Besides this, the principal aerial routes between the large cities, such as Paris to Marseilles and to the Channel, will have similar posts placed along them at short distances.

Wreck of the Schütte-Lanz Dirigible.—The strength and lifting power of balloons is seldom realized by the reading public until an air craft suddenly demonstrates its possibilities by cutting up capers without the guiding hand of a pilot. This was forcefully brought out on the recent (also its last) flight of the German dirigible "Schütte-Lanz I," which sailed from Königsberg on July 13th for Berlin, but was compelled to alight at Schneidermühl to replenish its supply of hydrogen. The ship was moored to an anchor sunk six feet in the ground and as an additional precaution a force of 300 men from the neighboring garrison were ordered to be ready to hold the balloon down in case of a storm. During a high wind one of the cars, a motor and several instruments were damaged. While repairs were in progress a violent gust struck the vessel, raising the stern about 100 feet in the air. The soldiers were so completely taken by surprise that all but two released their hold on the ropes. One of these fell from a height of 30 feet and was badly injured, while the other clung to the vessel until it had risen to nearly 1,000 feet when he also released his hold, and dashing earthward, was immediately killed. The ship hovered over the town for nearly an hour and then gradually descended. Driven along by the wind close to the ground it bowled over trees and telegraph poles in passing. A large body of peasants endeavored to arrest its flight by tying its cables to fir trees. The straining of the large bag, however, soon tore the trees up by their roots. When a sufficient quantity of the gas had escaped the ship collapsed in a forest with its framework broken and the machinery demolished.

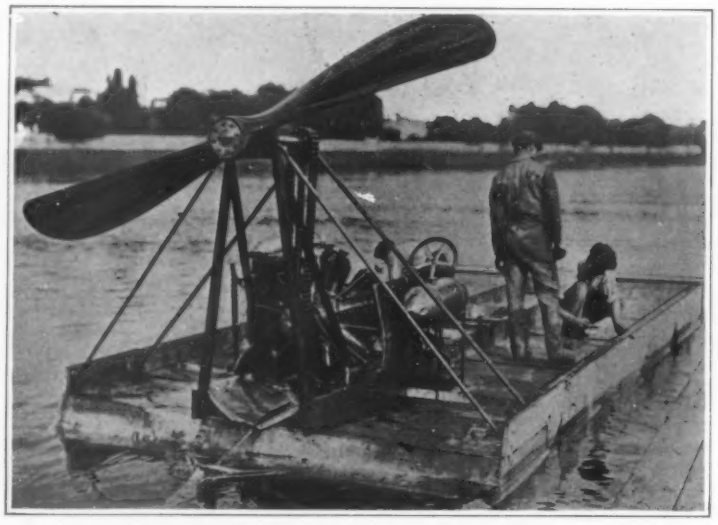
A Curious French Gliding Boat

ON the Seine at Triel, France, a curious looking craft is attracting much attention. It is a water glider propelled by means of an aeroplane motor and aerial screw propeller, but resembles in no small degree a scow or raft. This new "flyer," as it is termed by its designers, is owned by M. Paul Tissandier, and was built for him by Comte de Lambert.

The glider is really a kind of hydroplane, for it consists of five light floats or steps, to which the deck is attached, the total length of the craft being 7 meters, or nearly 23 feet. It is equipped with a 160 horse-power Gnome engine, and is credited with a speed of 85 kilometers (nearly 53 miles) per hour. When skimming along the surface of the water at this speed, the floats are almost entirely out of the water, and if wings were attached at the sides the craft could be converted into a hydro-aeroplane.

Comte de Lambert's experiments with gliding boats and similar machines date back nearly twenty-four years. In 1893 he fitted an 8 horse-power steam engine to a Tissandier glider with the propeller under water, and a speed of 23 kilometers per hour was obtained. Several different motors were tried by Tissandier and it was with his Buchet engine attached to a dirigible balloon that M. Santos-Dumont made his first memorable trip around the Eiffel Tower.

The deck of the glider is built over five wide floats.



New Lambert-Tissandier "Flyer" uses a Gnome engine and air propeller.

Shifting Gears by Electricity

WITH the successful employment of electricity both for lighting the modern automobile and for starting its motor as well, an additional step toward the evolution of the hoped for "push-button-operated" car has been made. And now the gear shifting problem, too, has been successfully solved with the aid of electricity.

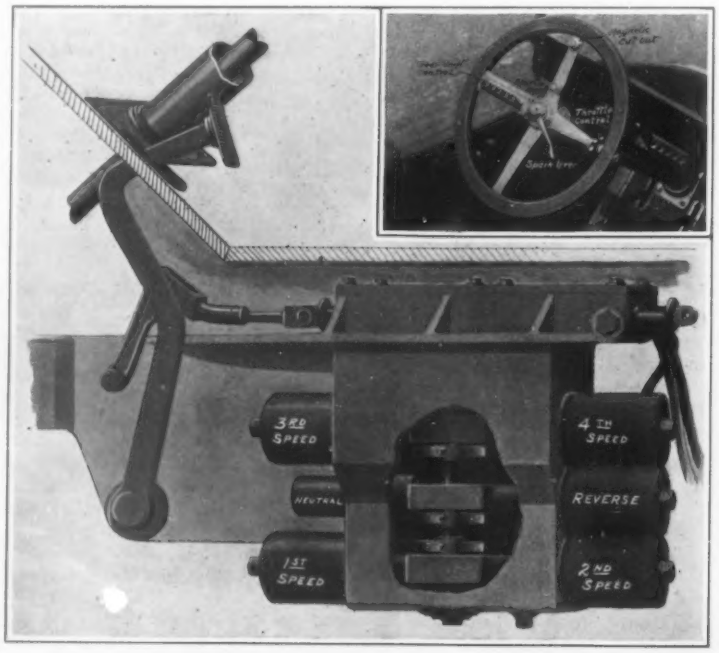
Nearly a year ago the first electrical device designed to permit quick alteration of gear ratios by the mere depression of a button made its appearance in Detroit, Mich., but it never proved a commercial success. Recently, however, a second device of the kind was placed on the market, and so successful has it proven that already it has been adopted as standard equipment by several prominent automobile manufacturers, thus making plain that it is a device that must be reckoned with. Like its predecessor, its vital principle is magnetism. It operates in conjunction with a combined electric lighting and engine starting system.

Despite the complication that generally attaches to things electrical, the mechanism is extremely simple in its essential elements; the whole of it is contained within the gear case, and it is therefore fully protected from accidental damage and from dust and dirt. In fact, it is more mechanical than electrical. Instead of being alternately connected with a sliding hand lever working in the ordinary H-gate quadrant, each of the gear shifting arms has its own powerful solenoid which is operated from the battery that serves to operate the engine starter. The amount of current drawn is small—about 15 amperes—and as the contact is only momentary the effect on the battery is negligible, particularly in view of the fact that the battery is constantly charged. The pull of the solenoids has been calculated as about 150 pounds, which is several times that ordinarily obtainable with the usual hand lever; consequently gears are quickly and easily shifted.

The control of the apparatus is vested in a row of six small buttons arranged as shown by the accompanying illustration, on one of the supporting arms of the steering wheel. It will be noticed that the gear shifting lever is absent, the remaining lever being the emergency brake control. The control buttons are arranged like the buttons of an inter-communicating telephone system; which is to say, that when one is depressed it stays down until another is depressed, when the first automatically springs up. This is to prevent the possibility of two gears being engaged at the same time, though even if this were possible the pull of opposite solenoids would result in no movement.

All of these six buttons, numerated from 1 to 4, for the four forward speeds, "N" for neutral and "R" for reverse, are connected in multiple with a master contact operated by the clutch pedal; hence, any of them can be left depressed indefinitely without causing a drain on the battery, for no current will flow until the master switch is closed by the depression of the clutch pedal. Thus, the clutch can be disengaged without the necessity for changing gears, three inches of clutch pedal movement being provided before the master contacts come together.

In operation, the button marked 1 is depressed and then immediately the clutch pedal is depressed to the limit of its travel, which would be necessary in any case to engage the gear by hand; first speed is obtained automatically without further attention from the driver. In other words, depression of the control button makes half of the contact between the battery and the solenoid, and depression of the clutch pedal makes the other half, when the pull of the solenoid on its core, which is attached to the gear shifting arm, shifts the gear. The method of obtaining any of the other gear ratios is exactly the same, the depression of any other button (except the neutral button) causing the indicated gear to be shifted into the driving position. The "N," or neutral, button is provided to permit any of the other buttons to be released when the car is brought to a final stand-still.



Press a button and shift your gears.

How Fish are Adapted to Depth of Water

CERTAIN fish living on river bottoms have the swimming bladder protected more or less by a cartilage or bony covering, and as M. Otto Thilo remarks, it is curious to note that fish which live upon the sea bottom have no such protection. The covering may be only partial, as in the carp, ranging up to a complete covering as is found in the *Cobitis fossilis* which lives almost entirely buried in the mud. There is a perfect adaptation between the structure of the swimming bladder and the fish's habits. When the bladder is full of air it tends to lengthen and compress other organs. In the *Sarcodaces odoi* of the Kameroon region, the bladder contains but little air, so that there is scarcely any strengthening to be seen here. An extreme case is found in the carp, and as the swimming bladder is much filled out with air it is protected by a shield in front, preventing it from pressing on the heart and esophagus. Were it not so, the bladder would hinder the blood circulation and respiration. Thus the amount of protection keeps pace with the filling out of this organ. In some cases the bladder has a fine elastic inner membrane surrounded by a stouter one, thus resembling a rubber tire.

While river bottom fish have an ossified swimming bladder, in sea bottom fish it disappears altogether in most cases. The nature of the bottom may account for this difference. The air bladder of a fish entering and leaving soft mud has time to adapt itself to the different pressures. In the case of the *Plics*, living in sea bottom in a hard and compact sand, the fish makes a great effort to penetrate into the sand, and when it comes out suddenly its highly-compressed bladder would expand so much that it would be in danger of bursting. Hence, in this case the bladder disappears, owing to adaptation to surroundings.

Caste in the Social Insect

THE study of social insects such as the termite has always been of interest, especially regarding the division of such insects into castes, each caste showing a difference in appearance. The white ants have several castes such as soldiers, workers and reproducers or sexuated insects. Owing to their defensive rôle, the soldiers are wingless, but have very strong mandibles, while the workmen, charged with building the ant-hill and bringing in food, have a characteristic form; like the soldiers, they do not reproduce. On the contrary, those of the caste known as reproducers have their organs well developed, and their only office appears to be that of reproducing the species.

Prof. Bugnion, a Paris scientist, is occupied with the problem of ascertaining when these different forms of the ant begin to appear. Hitherto it was thought that after hatching, all the small ants had the same shape, and later on became soldiers, workers or reproducers, this being accounted for by differences in feeding or the presence of parasites in the body. The author however shows that on leaving the egg the insect has its characters well marked so that the caste can be seen. For instance, in the *Eutermes lacustris* the soldiers have a frontal horn which is lacking in the others, and this horn is observed even in newly-hatched specimens. In other species the mandibles can be distinguished even at this early stage, and in general the division into castes, like that of sexes, before the birth of the larvæ.

Professor Ernst Meumann.

Teaching from the Child's Point of View

A New Science Created by Prof. Ernst Meumann

By Dr. P. R. Radosavljevich, New York University

Apparatus for measuring blood pressure.

Pedagogy in this alleged twentieth century is about in the same condition as was astronomy in the time of Galileo. A science is needed to determine individual differences among children. When that science is developed we shall be able to classify, grade and promote pupils scientifically, and not divide them according to ages or sizes or school marks as we now foolishly do. Some day we will have a real science of experimental pedagogy. A beginning has been made by Prof. Ernst Meumann. This article, written by one who has studied under him, sets forth in a simple way the basic principles of that science. Some day when the new pedagogy will have assumed the importance and dignity of botany or chemistry we will find in every large community a clinic where parents and teachers may receive advice on school matters, a bureau which will act as a consulting engineer in educational affairs.—EDITOR.

THE problems of education underlie all vital problems. The evidence? You will find it in the fact that every revolution in the history of thought was followed by revolutions in the history of education. It is not without reason that we call our science of education "Pedagogy;" for to the Greek *paidagogos* was a man who took care of a child. If pedagogy means a systematic method of bringing the undeveloped mind under the influence of the developed, it is but natural that to the mind of a child this influence represents a human ideal to be attained. In a broader sense, education implies every influence that a mentally strong person can exert on another person. That includes even self-education. But in a narrower sense, education means school education.

Present school education begins and ends with the adult; for the adult teacher works backward on a basis of adult thinking. In other words, the teacher imposes his own ideas upon the school child. For that reason the science of pedagogy in this twentieth century has developed no further than physics or astronomy had developed in the time of Galileo, and that, despite the fact that pedagogy is two thousand years old. What a paradox it is that scientists spend years in closely studying the character and habits of animals and plants, but have as yet lavished no attention, scientifically speaking, on their own children and pupils. Parents devote more time to the cultivation of gardens and to embroidery than to the education of their offspring. Even governments have as yet done practically nothing in endeavoring to ascertain scientifically what are the conditions that are most favorable to the child's physical, mental and moral development, as compared with what governments have done in the development of agriculture along scientific lines.

After centuries of waiting, we at last find a beginning made to establish a new science of experimental pedagogy, a science which instead of following the old *a priori* methods, accepts the surer method of experimentation and acquires more accurate and positive knowledge about pupils—a knowledge both qualitative and quantitative, by means of which we can free ourselves from the tyranny of traditions as to what constitutes an average school child. When that science is developed we shall be better able to understand what basis there is for the pedagogical belief that schools must be respecters of individuality.

The new science of experimental pedagogy approaches all its problems from the standpoint of the school child. As might be supposed the new movement originated in Germany, the land of pedagogy. And the man who has made it possible, the man who gave the first impetus to the movement, is Prof. Ernst Meumann, now in Hamburg.

Meumann the Creator of a New Science.

Experiment is the guiding idea of Meumann in treating educational problems. His pedagogical laboratories in Zürich, Königsberg, Münster, Halle and Leipzig became the *sanctum sanctorum* of all his numerous pupils who would know the educational truth and understand the workings of the child's mind and the scientific character of pedagogical problems. But our chief obligation to him comes from his numerous experimental pedagogical writings. His "Lectures for the Introduction to Experimental Pedagogy" (in 3 vols.) indicate a vigorous progress in the science of education. It is the only book of its kind as yet in print. Here it is shown for the first time to what extent the method of experimentation has equipped educators with knowledge as to the facts of school children's development and reaction under instruction.

Prof. Meumann does not agree with James, Münsterberg and other well-known psychologists who claim that education has gained little from experimental psychological investigation; he holds that it has gained very much and pleads that pedagogical experimentation is slowly emerging as a field quite distinct from purely experimental psychology because its problems are more complex and are made with practical ends in view. Experimental pedagogy does not try always to reduce all problems to their most elemental form; it is more synthetic, while experimental psychology is more analytic. And then the teacher's aim is not the acquirement of psychology as a critical doctrine, but as an experimental study of his own school questions. Experimental pedagogy deals, therefore, mainly with the school children, including young women and young men. Meumann aims (1) to show that experimental pedagogy enables the individual teacher to be at all times quite clear in his own mind as to the justification of his pedagogical measures, and (2) to impress upon the teachers the necessity of seeking to answer all pedagogical questions from the pupil's standpoint in order to rid themselves of the conception current in older pedagogy that the child is merely an adult on a small scale.

Statistics vs. a Knowledge of the Child Mind.

Although Meumann admits that pedagogical theory has been the chosen field of amateurs and of self-educated persons, he fully recognizes the folly of those modern experimentalists who pile up statistical masses of apparent facts without, as a preliminary, striving to get a thorough-going analysis, i. e., without a full and clear conception of the psychological units involved. We have to keep in mind that a statistical conclusion is not a psychological interpretation, and that a psychological possibility does not mean necessarily a pedagogical necessity.

Meumann shows that in educational theory as well as in educational practice new fields and standpoints have been acquired or at least confirmed scientifically which previously had only a remote connection with school education or none at all. Educational legislation and pedagogical therapeutics or orthogenesis must be based on science, i. e., on general scientific truths, not on educational idiosyncrasies and personal partiality. First of all we must see the truth, i. e., we must know exactly what pupils are, what their development is, and for what they are fitted.

What is Intelligence?

Take for example the problem of intelligence. Are the differences between the bright and dull pupils differences in kind or in degree? What is really intelligence? Is it inherited or acquired, or both? Can we distinguish general intelligence (innate, unspecialized mental efficiency) from acquired knowledge, interests, dexterities, and from specific endowment, aptitude or talent? Some believe that the child is bad by nature (Francke, Palmer, Graser); others claim that the child is good by nature, but it is spoiled by its environment (Rousseau, Pestalozzi, Froebel;; still others claim that a child is neither good nor bad, it has only general unspecialized dispositions which may be developed in either direction (Wundt, Judd). Or, in regard to the pure intellect some believe that the child's intelligence is inherited (so-called *nativistic* theory of Galton, Pearson, De Candolle); others claim it is acquired (Sidis's *empiricism*); and those who share the theory of *genetism* (G. Stanley Hall, Dean Balliet, Horne) say that the child's intelligence is both inherited and acquired.

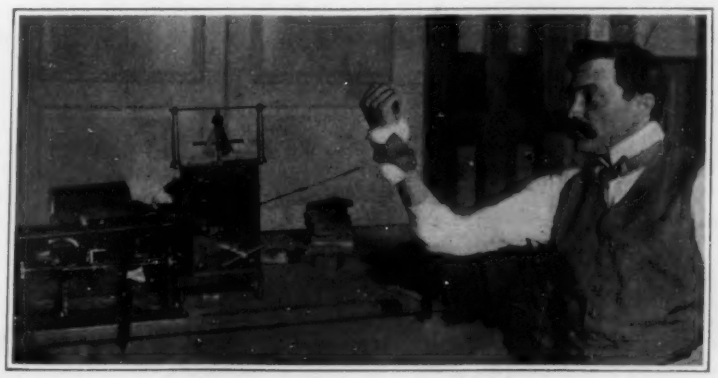
Meumann thinks that all these more or less different theories may be good for their own purpose, and a teacher who is dealing with a normal school child must judge a pupil's intelligence not only by its accomplishment of school tasks, but also by the energy (effort and time) expended in reaching this goal. Thus, three pupils may have the highest mark (A) in solving an arithmetical problem, but one did it in 3 minutes, another in 30 minutes, and the third in 60 minutes. All three had the same, highest mark. Which is the brightest? Or in memorizing a poem all three receive mark A, but one needs 3 repetitions, another 30 and another 60 repetitions. Who is the brightest? Meumann gives, therefore, the following formula to determine a child's school intelligence:

$$\text{School Intelligence} = \frac{\text{Work Done}}{\text{Energy Expended}}$$

Estimating Intelligence.

He mapped out a plan of studying general intelligence of normal pupils, dealing with it not as a whole, but only with some of its higher capacities. For these higher functions of intelligence he suggests material which involves the ability to work with abstract material in a purposive way, seeing new relations and breaking up old combinations. He disagrees, therefore, with those (e. g. Ebbinghaus) who claim that intelligence is the capacity to form new and original combinations, because a witty man does

(Concluded on page 152)



The ergograph is an apparatus used to study fatigue.

The Vast Ore Deposits of Cuba

By Henry Hale

(For illustrations see pages 146 and 147.)

THE discovery that Eastern Cuba is over-laid with a deposit of iron, accessible for mining without tunneling or shafting, which aggregates fully 500,000,000 tons or more, means that a new source of supply is available for the American iron and steel industry that is of the greatest importance. Less than ten years ago was this deposit investigated. In 1904 samples of ore were taken from a small area that were found to contain over 50 per cent of iron. This was followed by a more exhaustive study of what is known as the Mayari district, by pits 300 feet apart, with borings made with a 2-inch carpenter's auger in the bottom of each pit. At first, each foot of pit the borings were analyzed separately; but the ore proved of such uniform quality that samples were then taken of each 6 feet, by borings only, and the distance between these was increased to 1,000, 1,500, and 1,750 feet.

The only iron ranges in this country that can be contrasted with the Cuban deposits in extent are the Superior, which in their earlier history supplied 75 per cent of the ore consumed by American furnaces. James J. Hill was the pioneer in opening the Superior ranges. The large quantity excavated from the Menominee, Marquette, Mesabi and Gogebic—the largest ore beds—can be realized when it is shown by authoritative records of production, that during twenty years mining has been conducted on such a large scale that fully 250,000,000 tons have been taken out.

At the present time the annual output of ore is nearly 60,000,000 tons from the total ore mines of the country, of which Superior ore now represents about 30,000,000 tons of available ore of a quality for smelting, in contrast to the 75 per cent of the entire American output in its earlier era of mining.

The ore in its natural state contains a very large percentage of water, which increases to some extent with the depth below the surface. Near the surface it is red in color, with somewhat granular structure. The color gradually changes with depth, finally reaching a bright yellow. The consistency also changes toward the bottom to a clay-like, sticky mass. The relative proportion of red and yellow ore is quite variable; in some places the yellow reaches close to the surface, while in others the red extends almost to the underlying serpentine.

In the Mayari division of the Spanish-American Iron Company, the ore lies on an irregular plateau, about 15 miles long and 5 miles wide at the widest point, entirely covered with pine trees and brush, which grow directly on the ore. The elevation at the northern extremity, which is approached by the railroad, is about 1,700 feet above sea-level. At the southern end the general elevation is about 2,000 feet. Ore is removed by means of scraper-bucket excavators and steam-shovels, these machines loading into special standard-gage, side-dump steel cars of 100,000 pounds capacity.

The Spanish-American Iron Company is also operating hard-ore mines of the Daiquiri group, on the south coast of Cuba, about fifteen miles east of Santiago. The main ore property at Daiquiri, once considered as three separate mines, San Antonio, Lola, and Magdalena, has now developed into a practically continuous body of ore. The ore in the Lola mine can easily be distinguished from the waste by its darker color. The waste-banks are on the right and the ore-lowering inclines on the left. Both the ore and the over-burden are removed from a series of benches. Fourteen steam-shovels are employed for stripping, the largest of which is a 90-ton Marion carrying a 4-yard dipper. All are served by locomotives and trains of side-dump cars for removing the rock to waste-banks on the back side of the hill.

On account of the rock being mixed more or less with the ore, it is necessary to load all of the ore by hand into small cars, which are run to lowering-inclines. These inclines carry the ore in skip-cars to the main-line railroad, which runs from the foot of Lola hill to La Playa, the shipping-port at the coast, four miles from the mines.

A hoisting-incline is provided for raising coal, machinery, and general supplies from the main-line railroad to any level of the mine. A modern air-compressor plant is located along the railroad near the San Antonio mine, and a pipe-system is arranged to furnish compressed air for tunnel-exploration and for general service to any part of the mine. Steam-drills are used in the principal blasting-work. Ore is also brought from the Berraco and Sigua groups of mines, located to the east of Daiquiri, over a narrow-gage railroad joining the standard-gage main-line about two miles below Daiquiri mines. All of the ore is crushed before shipment in a Gates crusher-plant to sizes suitable for use in the blast furnaces.

The contour of the ground at the point where excavations were begun, in the Mayari district, though appearing to be quite regular, is not ideal for steam-shovel operation. The depth of ore is not uniform, in many places the underlying rock projecting far up into the ore, even to the surface. The general slope of the ground, even in the most nearly level places, is quite irregular. Therefore, it is difficult to find many places where it is possible to operate a steam-shovel for an extended period in a cut of economical depth without including a considerable portion of the rock with the ore excavated. For this reason the scraper-bucket excavators are more satisfactory as well as more economical for excavation, although their capacity is considerably less than that of the large-size shovel used. Three of these excavators are now at work, together with one 90-ton Bucyrus steam-shovel. The excavators operate 1.25-cubic yards Page buckets, although a larger capacity of bucket is contemplated. The bucket swings through a radius of 60 feet, and without difficulty removes all the ore for a width of about 100 feet down to the rock bottom, the projecting rock and stumps being discarded. Each machine-crew consists of one operator, one fireman, and three pitmen. As the machine works up hill or down hill continually, and the track follows the same grade, cars can be dropped down by gravity to be loaded as needed, with a minimum amount of locomotive service.

The nodulizing plant, located on the east side of the raw-ore yard, consists of twelve rotary kilns, 10 feet in diameter, and 125 feet long, set at an inclination of ⅝ inch per foot, and 20 feet apart. The kilns are of the type commonly used in the manufacture of cement. The diameter, however, is unusually large in order to overcome trouble from "ringing-up" in the hot zone, which often causes serious delays in the operation of kilns of smaller diameter. Each kiln is carried by two steel tires rigidly fastened to the shell. The cut-steel driving-gear attached to the shell close to the tire near the cold end is 152.78 inches in diameter, and 4 inches in pitch. Each kiln is driven by a 35 horse-power variable-speed motor. A 7.5-ton over-head electric traveling-crane, carrying a man-trolley with 3 cubic yards grab-bucket, is provided for removing the nodules from the trough of the nodulizing plant and loading them into 50-ton electric transfer-cars on the track passing alongside of the trough.

The construction at the water-front is somewhat unusual. Close to the front leg of the bridge, and parallel to its runway, is a trestle extending over one side of a trough. A transfer-car brings the nodules from the nodulizing-plant, and discharges from one side into this trough, in position to be readily loaded into the vessel, or to be moved back to storage under the main span of the bridge by the grab-buckets. The bottom of the trough is one foot above high tide. Its outer wall is formed by planking spiked to a row of piles. All of this construction, being above the water-line, is not subject to damage by the *teredo navalis*. From the outside of the trough-wall the bottom drops off at an angle of 45 degrees to 28 feet deep at the fender-line, which is approximately under the hinge of the boom of the bridge.

Considerable dredging was necessary in order to provide a suitable harbor. A basin 1,500 feet long, 200 feet wide at each end, and 400 feet wide at the widest point, was dredged to a depth of 28 feet. The approach-channel, 2,500 feet long and 200 feet width, was dredged to the same depth. Felton, on Cagimaya Bay, a well-protected branch on the south side of Nipe Bay, close to its entrance, has proved a very safe and satisfactory harbor.

Each year more investigations are made of the deposits beyond the mines opened, and the results confirm the statement that this and the Mayari beds contain fully 500,000,000 tons with an extensive area still unexplored. The tonnage available for steel making may be 600,000,000 or more, as only a half million tons or more of ore are mined annually.

Treating Tuberculosis by Marine Micro-organisms

MUCH has been written of late on Dr. Friedmann's tuberculosis cure by means of sea turtle microbes. In a memoir submitted to the French Academy of Science, Dr. Raphael Dubois, professor at the University of Lyons, draws attention to his own experiments on similar lines, begun as far back as in 1900. Twelve guinea-pigs inoculated with tuberculosis microbes, so as to become manifestly infected with the disease, were treated with a *micrococcus* derived from a pearl-producing shell-fish of the Hyères seacoast, and with a single exception, were kept alive ten months afterward. The seeming curative effect of the *micrococcus* was put down to its "calcifying" action as shown in the formation of pearls.

Now Dr. Dubois recently obtained from the veterinary department of the Toulon slaughter-house some calcareous concretions, as formed around tuberculous lesions in the lungs of two oxen seemingly in course of healing, and in the liver of a pig, respectively. From the calcareous shells of these lesions he prepared cultures of several species of bacteria, one of which, on microscopic examination, turned out to be a *micrococcus* similar to the one previously experimented on.

It should be borne in mind that in all cases of pathogenous calcification (pearls, calculus, pulmonary concretions, etc.) there is not only a deficiency of lime in the organism, but an incapacity to absorb any lime offered in abundance. In the case, e. g., of pearl formation, there is practically always a parasite drawing toward the infected part any migratory calcariferous cells, the same as microbes, in other cases, are known to attract phagocytes.

Under these conditions it will be interesting to watch the healing effect which the *micrococcus* in question may exert on the tuberculous guinea-pigs recently inoculated with it.

Fighting in the Air

By C. Dienstbach

IN the war of the future shall we see aeroplane pitted against aeroplane? It may be, and yet there are difficulties. In the first place, the atmosphere over modern fortifications and over the territory occupied by a modern army is vast. Unless opposing single aeroplanes deliberately ferret each other out, it may happen very naturally that they may be miles apart.

There is a psychological side to this situation. In his novel "When the Sleeper Wakes" H. G. Wells surmises the stress of a combat between aeroplanes in the air would prove too much for twenty-second century courage. It seems not quite within the possibilities of twentieth century courage—Bulgarian and Turkish aeroplanes, scouting at Tchatalja, did not attack one another—perhaps because there must be a reversal of the psychology of braving an attack from the ground. The ground is so remote—on such a different plane; but a machine rushing through the air at express train speed is fearfully on the same plane, and has the potentiality of getting so unpleasantly close that it over-emphasizes the danger of flying *per se*. A man without skates on smooth ice, or without spiked shoes on the top of a narrow steeple, is not aggressively inclined; the military aviator is in no more favorable position. To exchange chance rifle shots at great distances is psychologically too indecisive. On the other hand, if the opposing pilots approach each other at all closely, either may find himself rushing along into a situation as desperate for him as it is for his enemy.

Probably the first whole-hearted aerial attack in modern warfare will be delivered from a very large and safe dirigible, a craft that can at least boast of a practical firing platform, notwithstanding the danger of conflagration. The fact that Zeppelins have been armed with machine guns shows whither the tendency lies.

The Current Supplement

IN this week's issue of our SUPPLEMENT, W. J. Humphries contributes an interesting article in which he shows that the presence of volcanic dust in our atmosphere has probably played a most important part in determining the climate of our earth in past ages.—A general review is given of the modern status of electro-therapeutics.—Our readers are well acquainted with thermite and its uses. A field in which it seems to promise particular usefulness is the repairing of damages to sea-going vessels. This application is described and illustrated in an article by L. E. Browne.—The lighting of the modern manufacturing plant is an important problem, and not only from the point of view of humanity and sanitation, but also as a purely commercial consideration, in view of its direct influence upon manufacturing efficiency. "Making the Best Possible Use of Daylight Illumination" is the subject of an article dealing with this topic.—Prof. H. B. Dixon, working in conjunction with C. Campbell, reports on investigations regarding the effect of incombustible dusts on the explosion of gases.—Prof. P. Behrens writes on the Aesthetics of Industrial Buildings, that is to say, on beauty in technical structures, as determined by perfect adaptation to useful ends.—An article entitled "Our Life Blood" tells us many remarkable facts regarding a constituent of our body which is not only most important for life, but also full of interesting properties.—C. A. Battiscombe describes a very promising scheme for exploiting the power of the tides.—F. Campbell writes on Curiosities of Binocular Vision.

A Monument to Schiaparelli

A COMMITTEE has been formed under the patronage of the King of Italy to erect a monument to the astronomer Schiaparelli, and it is to be erected at Savigliano, where this celebrated scientist was born in 1835. He died at Milan in 1910. A commemorative tablet will be placed in the Palazzo Brera where he made his principal discoveries, and if sufficient funds can be raised it is intended to found a scientific institute. The committee in charge of the affair includes well known state officials and scientists, including Prof. Celoria, director of the Milan Observatory.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

What is the Maximum Parcel Post Cylinder?

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Taylor's "The Maximum Parcel" in your issue of July 19th is interesting and instructive. The solution in case of the largest rectangular package is easily obtained; but to find the maximum of a cylinder with spherical ends seems difficult. Many of your readers, I doubt not, would be grateful for the solution.

Roan Mountain, Tenn. O. S. BERTOLET.

The Automobile and the Locomotive

To the Editor of the SCIENTIFIC AMERICAN:

On page 14 of your issue of July 5th is a photograph of a 110-ton locomotive being towed by a 2-ton automobile. Let me call your attention to a slight mistake in your story.

The car in question is a Studebaker (E-M-F) "30," which is of 30 horse-power and not 40, as your story states. And in addition, the car weighed less than 3,000 pounds without its load.

This makes the feat rather the more remarkable.

THE STUDEBAKER CORPORATION OF AMERICA,
W. S. PETTIT, Advertising Manager.

Detroit, Mich.

Lightning Prints

To the Editor of the SCIENTIFIC AMERICAN:

I observe with interest a quotation in the *Literary Digest* taken from your issue of June 28th in which Charles F. Talman holds that "lightning prints" are simply traces of the branch-like course of the discharge. My own observations tend to verify his statement, for I have seen those imprints upon horses and cattle killed by lightning on the buffalo-grass plains of the West in places where the nearest tree was miles distant and in some instances where there were no trees or other objects than stock within sight. I have seen a number of variations of these "prints," and in many cases the hair was burned in distinct lines down the animal's four legs to the hoofs.

Newton, Colo. C. H. SMITH.

An American Coffee Made of Figs and Prunes

To the Editor of the SCIENTIFIC AMERICAN:

Relative to your article regarding the Feigen-Kaffee of Austria, there is made in America, at San José, commercially, an article out of figs and prunes which is so superior to coffee that if people did not use the real coffee for the narcotic effect, it would entirely supplant coffee. The flavor is delicious and rich, the color fine, and moreover it is even improved by warming over. Less is required than of coffee. It is a real food and rich in phosphorus. Of course, the advertising feature prohibits the mention of its name, but I did not like to have Austria carry off any honors in this respect when we have something better at home. It is really too bad for the health of the nation that the concern which manufactures the product does not exploit it outside of a small local territory. O. F. G. DAY.

Minneapolis, Minn.

The Automatic Railroad Stop

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest your article in your issue of July 19th, entitled "The Competition for the New York, New Haven and Hartford Railroad Company's Automatic Stop." This article affords a very good idea of the great amount of interest which inventors as well as the general public feel on the subject of automatic train control. Recent occurrences in the railroad world lamentably emphasize the importance of the subject.

One general impression, however, though held very widely, is erroneous, and this your article tended to enhance rather than correct. It is true that most of the devices and plans thus far submitted have been impractical. Nevertheless, anyone who has made a careful study of the subject knows that a number of devices already offer considerable promise and that an occasional one appears fairly satisfactory.

It is to be remembered too, that in spite of the widespread interest in Mr. Mellen's $10,000 competition, numerous inventors have preferred, for reasons that need not be mentioned here, to perfect their inventions under private auspices.

There are three classes of automatic stop devices. The first is mechanical, represented by the system used in the New York subway and elsewhere. The second kind is of the electrical type with continuous contact, using electric current picked up from a third rail. Of this type you mentioned two systems in the article referred to.

The third kind is also of the electrical type, but operates by "wireless" or induced current. Probably the best example is that known as the Detroit automatic train control, a description of which is printed in the July issue of the *Signal Engineer*. It is to be noted that this device conforms to the primary requirement of the Train Control Board of the Interstate Commerce Commission, to which, as you state, the seven hundred and four devices submitted in the competition failed to conform. In other words, this device is designed throughout on the closed circuit principle, so that the failure of any part is self-detecting. Moreover, this system appears to conform to all the other requirements of the Train Control Board. An additional feature of especial interest is that it may easily be equipped with the wireless telephone.

It seems to be worth while to bring to the attention of those interested in this important subject that the competition of the New York, New Haven and Hartford Railroad Company does not necessarily represent all the ideas of American inventors. It is, therefore, not to be assumed that there exists no system that will minimize the serious disasters which blot the record of our railroads. F. MCHENRY.

Detroit, Mich.

Mr. Hanna Replies to Mr. Linton

To the Editor of the SCIENTIFIC AMERICAN:

It was, indeed, not necessary for Mr. Grant Linton to explain that the inaccuracies in his first letter on the subject of flexible fabric aeroplane wings were due solely to a desire for simplicity. Nor should it be necessary for me to say that this painfully excessive "simplicity" was what demanded my criticism. Simplicity ceases to be a virtue when it degenerates into hazy generalization. Aerodynamics is an exact science, and it is not possible to airily ignore certain forces, however slight, or disregard differences of direction, however slight, or say merely "an angle of incidence," without the least indication of what limits the angle may lie in. Such crudities will most certainly invalidate all conclusions. The proper place for Mr. Linton's simple theories was his private note book, there to remain until he had developed them to an exact, concrete, and practical enough form for public presentation. The majority of the SCIENTIFIC AMERICAN's readers, I believe, have quite sufficient mental capacity to comprehend a much more scientific and accurate presentation of this fabric wing theory.

Aviation is, in these sad days, afflicted with too many rocking-chair theorists, who rush into print with every wild idea that pops into their heads, and is blessed with too few men of the type of Langley and Eiffel, who devoted their lives to proving their theories in their laboratories before talking about them; too few men of the type of the Wrights and Blériot, who embodied their theories in actual machines and proved them at the risk of death. God speed the day when the proportion shall be reversed! A full half century ago there were almost as many men with impractical flight theories as there are now, but it was not until the coming of men strong enough to put good theory to actual test that flight became a reality.

However, I do find it necessary to defend myself from unjustifiable misquotation. I did not, as Mr. Linton asserts, "confess ignorance of the truth of his statement that 'in both classes of vehicles the best efficiency could only be obtained by altering the length of the chord.'" My actual words in the issue of May 10th, page 431, are plain enough. And to this day I have not heard anyone of aeronautical standing assert that increased efficiency could be attained only by lengthening or shortening aeroplane ribs in flight, nor do I know of any sail adapted to change its width from mast to outer edge, that is, its chord. To be sure, if a sail bags out to a deeper curve, its chord will decrease slightly. If Mr. Linton means that the best efficiency can only be obtained by changing the *camber* of the plane, why did he not say so? I would suggest that the book department of Messrs. Munn & Co. can supply him with a modern dictionary of aeronautical terms. It is by no means necessary to shorten the chord of an aeroplane wing to increase the camber, or *vice versa*. I instance the British patent (No. 18,604, 1910) to Esnault-Pelterie for a wing of variable camber.

I must beg Mr. Linton to learn what the Cary Smith roach reef (the misspelling *reach* in my former letter was the printer's fault) really is before he accuses me of inconsistency in mentioning it. It is purely a device for altering camber, not chord nor area, and has no resemblance to the usual reef which merely reduces the sail area, not for efficiency; since Mr. Linton says that "exquisiteness of detail is just as an important a matter, and more so, in the design of the aeroplane than in the design of the sailing yacht," he ought, to be consistent, to put a little more exquisite and accurate detail and less vague and inexact generalization into the exposition of his theory.

Again, I did not "assume that, because the upward component of the air pressure is uniformly distributed over the surface, the total air pressure is likewise," as Mr. Linton asserts I did. On the contrary, I denied such a possibility, and cited Eiffel's experiments as proof. My attitude was so clear that such a glaring mis-statement is difficult to understand. Pictures are generally easier to comprehend than written descriptions, so I would suggest that Mr. Linton may best secure his first knowledge of the actual conditions of air pressure around an inclined plane by consulting the excellent graphic charts of Eiffel's pressure measurements that Mr. E. R. Armstrong gives on page 418, vol. iv, *Aero and Hydro*.

I am afraid Mr. Linton is jesting when he proposes to subject the two sides of the fabric to the air flow singly. For certainly the unbalanced force on one side would deform the fabric out of all possible wing shape, and if by any complicated apparatus this result could be avoided, the conditions would still be wholly different from those of actual flight, and consequently the data obtained would be useless. The lift of a plane is not only dependent on the pressure below and depression above, but on the extent to which these two *simultaneous* forces are mutually neutralized and destroyed around the edges of the surface.

I still think that the belief in the parabola as the only correct basic curve for wing sections belongs to the past. The only authority for it Mr. Linton cites is Montgomery. I could name a dozen others, but they are all, like Montgomery, men who theorized in the days before aeroplanes were living, everyday realities, disproving with monotonous regularity one after another our preconceived mathematical theories, such as Newcomb's proof of the impossibility of mechanical flight and Navier's mathematical proof that one swallow required one seventeenth of a horse-power to fly.

I was aware of Major Reber's comment on the regular speed of Vedrines in the last Gordon Bennett race. But we cannot judge aviation as a whole by the performance of one highly specialized racing machine. And I am quite sure that Major Reber himself would never sanction the purchase, for actual army use, of any aeroplane that could not show a much greater speed range than this Deperdussin racer did or could show.

The most absolutely ignorant and erroneous statement of Mr. Linton's is this gem: "Though 'the ability to vary the speed of horizontal flight within wide limits is a most desirable quality of the aeroplane,' this feature (as attained at present) is only a proof of poor design, or at least of inefficient running." I must gently but firmly decline his offer to inform me that "the biplane is by no means acknowledged the most highly specialized type of the heavier-than-air machine." The biplane has been developed as far in its sphere as the monoplane; it is a type that is here to stay; and it is, for structural reasons, the type of the large machines of the future. It flies by the same processes, and obeys the same laws, as the monoplane does. Consequently, facts proven by it cannot be ignored. However, if Mr. Linton prefers data derived from monoplanes, I call his attention to the performance of the Hanriot, Blériot, Bristol, and Deperdussin monoplanes in the British military trials. These machines showed speed ranges of 25.6 per cent, 47.3 per cent, 26 per cent, and 26 per cent, respectively. To take a more recent instance, at Villacoublay, on June 21st of this year, des Moulinais obtained a speed range of between 38½ and 81¼ miles per hour on an 80 Gnome Morane-Saulnier monoplane, while Gilbert, with a 50 Rhone machine of the same make, obtained a range of between 41½ and 73¼ miles. In every case these ranges were the product of the deliberate efforts of some of the world's ablest designers and pilots. Mr. Linton should be familiar with the experiments to increase the speed variation of a Farman biplane which the National Physical Laboratory of England has just concluded so successfully. Does he accuse that honored institution of poor design?

The fallacy of flexible fabric, whether for actual wings or as a means of ascertaining the best wing curvature, is at once evident if we will remember that the object of a wing is to deform the air in the manner most advantageous to us, rather than to permit the air to deform the wing in the manner most advantageous to it. Anything that favors a certain motion must necessarily be unfavorable to the equal and opposite reaction.

In these two letters I have said all I care to on the subject, and I believe that Mr. Linton has made his position clear also in his two letters. I suggest, then, that the case should now be placed in the hands of the jury. Let us have, through the columns of the SCIENTIFIC AMERICAN, the opinions of others, perhaps better qualified to judge than either Mr. Linton or myself.

Galveston, Texas. JOHN G. HANNA.

Buying and Selling Silver and Gold

The Scientific Side of the Assay Office at New York

By H. J. Slaker

THE public has practically two relations to the Assay Office at New York; first, that of selling gold and silver to the Government, and, second, that of buying both of these metals from it. With some exceptions, the Government buys any amount of gold from any individual and pays $20.67 an ounce for the gold contents. If the deposit contains silver also, it is either paid for at the market price, or its equivalent in fine silver is returned to the depositor.

The purchased deposit may represent the product from a mining company, dental scrap, an import of gold from Europe, or discarded jewelry. If the jewelry could tell its history, one might learn many a story of poverty and broken pride, for many times old family heirlooms, or even historic emblems, in chased gold and silver, are handed in at the window of the Assay Office. The very day these deposits are received they lose their identity, for they pass immediately into a crucible, are melted and cast into the form of an uninteresting bar. The Government accumulates a great variety of sizes of bars, having many different finenesses.

When the public wishes to buy gold, it demands its product suitable in every particular for the various trades which utilize this metal, and the high grade metal produced by the Government meets these demands. It may be the dental profession wishes material for filling teeth, in which case an exceedingly high grade gold is desired, since a trace of impurity interferes with the cold welding. Or again, the gold beater's business demands metal close to absolute purity, so that the leaves may be pounded to an exceedingly great thinness. The jeweler's trade is not so insistent on great purity, but must have gold which is not brittle. Also the Government itself turns a large part of its refined gold into coin, which, in turn, goes into circulation, having been received in exchange for gold bars from the public. A pure product answers all these requirements.

Between the purchase of impure gold from the public and the selling of pure gold to the public, there is necessarily a series of operations, which is known as refining. Several different processes of refining have been in use, all of them open to some objection, such as fumes, great cost, or excessive loss of the precious metals. The electrolytic method, after an extended test of several years, has been installed in all the Government refineries. In principle, this is a plating process very much resembling that of silver and gold plating, with the exception that instead of a smooth deposit, which appeals to the eye, a deposit of quantity and purity is obtained. In actual practice the anode is a bar made from the different deposits, suitable in fineness and form for the process, while the cathode is a thin strip of pure metal upon which the deposit is gathered and is of the same metal as the deposit. So long as certain conditions such as voltage, strength of electrolyte, etc., are kept constant, nothing but the desired metal will be deposited. Part of the duties of the working force is to keep these conditions constant.

The operations are divided into two parts, known as silver refining and gold refining, and while they more or less overlap, they will be considered in this order.

Silver Refining.

Practically all deposits under 900 fine in gold are sent to the silver refinery, while those above that go directly to the gold refinery. The silver anodes (3 inches by 16 inches by ⅜ inch thick) are made directly from the deposits received over the counter and are alloyed to one another so that the resultant melt will be kept within the following limits: gold, 250 to 400; base, 150 or under; and remaining parts silver. To keep within the limits mentioned, this selection of the various deposits requires much patience, because of the great variety of the weights and finenesses, but by constant practice one becomes expert in this detail. The necessity of handling as much as 150 parts base and also such a large proportion of gold makes the electrolytic method difficult. A cupeling treatment has been suggested, but the losses of gold and the great values tied up in furnaces seem to prohibit this. Each anode is put into a muslin bag tied at the top and suspended in the electrolyte by means of a small gold hook. The hook passes through a hole, made at the time of casting, in the top of the anode and is hung over the conducting rod. The conducting rod is composed of a hard rubber tube reinforced through its center with cold rolled steel. The electric current is carried by means of a thin strip of silver which is half-rounded over the hard rubber tube and fastened by tape at each end. It will be noted that both gold and silver are used to carry current; this is because they give good contact and do not corrode.

Anode melting furnaces.

Electrolytic gold cells.

The cells (brown stoneware, 2 feet by 4 feet by 2 feet deep) are arranged in two sets of sixteen in series, placed close together on soapstone slabs of proper height. The eighteen supporting rods for each cell are spaced 2½ inches apart and this distance is maintained by hard rubber separators placed on the rims of the cells. Each supporting rod is double the width of a cell, so that one rod extends over two cells and serves the purpose of an anode support in one and a cathode support in the next. This plan allows the use of the shortest possible strips for conductors and also eliminates many contact difficulties. There are nine anode and an equal number of cathode rods for each cell, carrying a total of 43 anodes and 43 cathodes uniformly distributed. A glass propeller in each jar, driven by a motor-operated belt, gives the necessary circulation to the electrolyte.

The electrolyte contains 3 per cent silver nitrate and 2 per cent of free nitric acid, and this strength is maintained by adding either acid or silver nitrate.

The action of the electric current is interesting, for in passing from the anode to the electrolyte, it dissolves silver and base metal, leaving gold in the bag as a coherent spongy mass; and again in passing from the electrolyte to the cathode, the electricity leaves the base metals in the electrolyte and plates out nothing but the silver. Thus a satisfactory separation is made between silver and gold at the anode and between silver and base metal at the cathode, while all the component parts of the original anode are in a state to be relatively easily regained.

Every eight hours each cathode is lifted out and the loosely adhering silver crystals are scraped into a vat, washed, and then melted into merchant bars for the trade. This is the fine silver product of the refinery. Some of these crystals fall to the bottom of the tank and are regained at the time of the renewing of the electrolyte. If the necessary care is exercised, the result is very nearly pure silver, not containing more than a half part in a thousand of foreign metals. The gold contents of this deposited silver are watched carefully and not allowed to exceed two parts in a hundred thousand. Just how this gold finds its way into the silver is unknown, but it is believed it is introduced mechanically, rather than chemically or electrically. However, gold, platinum and palladium can be found in the foul electrolyte in exceedingly small amounts. On account of the rapidity with which the electrolyte becomes foul and the necessity for "newing" this frequently, a hard rubber centrifugal pump removes the solution from the cells and forces it into the precipitating tanks, where it is treated to regain the valuable metals. Copper slabs throw out the silver and

other metals which are precipitated by it in the form of a slime, which is washed, melted and passed through the electrolytic process a second time. The solution from which the silver has been precipitated is allowed to run off to the sewer. The low current density of seven amperes per square foot is used in order to prevent the base metals from plating over with the silver, and also in order to obtain a more coherent crystal form.

When the spongy anode gold is removed from the bags the silver has not been completely extracted, but a sufficient amount has been removed to enable the metal to pass on to the gold refining. Practically all the platinum and palladium remain with the gold and are regained further along in the process.

Gold Refining.

The gold which comes from the anodes of the silver refining, together with the gold in the original deposits which are high enough in fineness to be suitable, pass through the gold cells. These cells (14 inches by 19 inches by 12 inches deep) are Royal Berlin porcelain because this ware withstands the chemically active electrolyte. The general arrangement of the gold cells and the conducting rods is somewhat similar to the silver system. The hard rubber rods are covered with a thin strip of gold for carrying the current and the circulation is obtained by hard rubber propellers driven by a motor. The electrolyte is composed of 30 grammes of gold as gold chloride to the liter with some free hydrochloric acid. The anode (8 feet by 3 feet by ½ foot thick) is slightly wedge shape in order to prevent the bar from being eaten off near the surface. The portion which remains above the solution has a hole near the top, is reduced in thickness and has corners cut off. The silver contents of the gold anodes, if above 5 per cent, form an insoluble silver chloride coating which prevents the solution of the anode and eventually gives off chlorine gas.

It becomes necessary to remove this coating either in some mechanical manner, as scraping by hand, or by an electrical device. The latter device is now being used with a fair amount of success.

An alternating current is run in series with the direct current, the resultant wave being a pulsating current through the cells. Its principal effect is to keep the anode clear from the insoluble silver chloride, but it also lessens the amount of free hydrochloric acid necessary and reduces the amount of gold in the slimer. An effective current density of 70 amperes per square foot is maintained, which is increased if a higher anode fineness is used.

There are four sets of twelve cells each placed upon soapstone slabs at a convenient working height.

The slimes and the electrolyte contain all the metals which were in the anode, and it is in this solution that most of the platinum and palladium gradually accumulate. When the solution becomes foul, the platinum is precipitated by sal-ammoniac as platinum ammonium chloride. An excess of sal-ammoniac is used and the surplus serves, after an oxidizing treatment, to throw out the palladium. The solution from which the platinum has been precipitated is syphoned into a clean jar and some potassium chlorate with a small amount of potassium permanganate is added. This throws out the red salt of palladium ammonium chloride.

The by-products of platinum and palladium are sold to the highest bidder and the proceeds are added to the United States Treasury.

The slimes are washed and the silver chloride reduced by metallic zinc, and after adding a certain amount of silver they are cast into anodes for the silver cells.

Equipment.

The equipment of the deposit melting room consists of one standard melting furnace and three medium sized furnaces using oil for fuel; seven gas furnaces of a somewhat smaller capacity than the medium sized oil furnaces and two smaller gas furnaces for the small deposits. The use of both gas and oil in the deposit melting room is to insure an uninterrupted service under all conditions and yet to obtain the high temperature and economy of the fuel oil. It would be possible in case of a severe snow storm to do all the melting by gas in this particular room.

The benches, dumping pans, settling tanks, etc., have all been made fireproof; that is, there is no wood in their construction.

A special lead-lined iron tank with a pan and washing sink above was installed on this floor with its overflow running to a large settling tank in the basement. This system of traps practically insures the wash waters which run to the sewer to be free from value. The pressure blower system which gives air to all the furnaces in the building, and has given perfect satisfaction, is rather different from that generally in use for similar purposes. It is known as a centrifugal compressor and has a rotating element mounted upon the common shaft with the driving element of the motor. This eliminates all gears, belts, chains, etc., and the compressor runs the same speed as the driving motor. The air pressure is constant through all loads and the power consumption is proportional to the load.

The melting room of the melting and refining department has eight standard oil furnaces arranged around a square, and with the necessary tanks, pans and benches, furnish the equipment of the room. The square, which is in the middle of the room, is built of firebrick and so constructed that it constitutes a settling chamber with the outlet leading from its center to a large flue off to one side. The flue is vertical and connects all furnaces throughout the building to a large settling chamber on the ninth floor. The construction is such that all flues and settling chambers can be easily cleaned and the values obtained from the dust.

The standard furnace is so built that the burner looks directly down in the combustion chamber, which arrangement puts the blow torch flame against the bottom firebrick instead of the crucible, as is usual in many of this type of furnace.

The make-up room and office occupies the other half of the third floor and contains the necessary working desks, two large scales, one long table with soapstone top covered with leather, and the working vault. The vault has a lowering platform before the door, which allows the floor level of the vault to be the same as the room. The vaults throughout the building have the same construction, and this has proved to be of great value because it allows the heavy trucks to be moved in and out easily.

The sixth floor contains the shop and the electrical dynamos for producing the proper current for the refining cells, the switchboard and controlling devices. The three low-voltage machines are separately excited from an outside source and are so connected through the switchboard that any machine can be used on any circuit. The machines are duplicate, and each is capable of producing 1,200 amperes at 20 volts, but only one is run at a time.

The third machine was specially built to produce the pulsating current by placing an alternating current in series with a direct current. This is accomplished by mounting on one bedplate four machines, a driving motor, a direct current dynamo, a single phase alternating current dynamo and an exciter. One lead from the alternate passes directly to one lead of the direct current machine and the other two leads go to the gold cells.

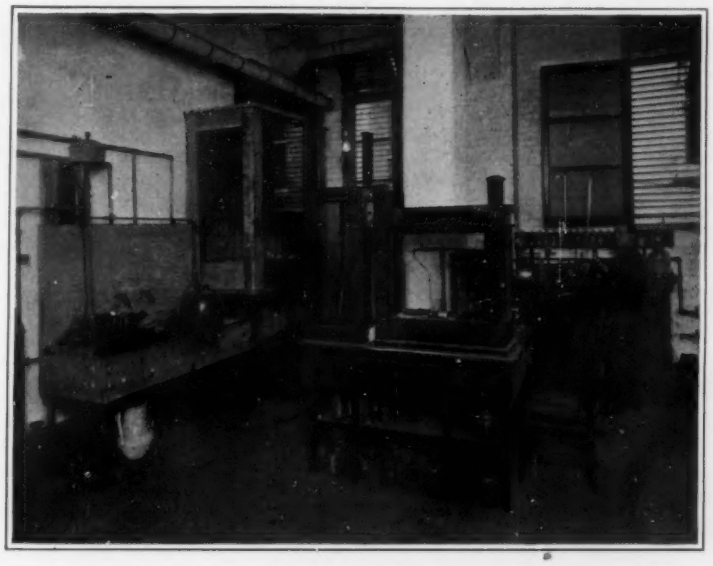
The controlling device is unique because of the fact that the 110-volt exciter excites the fields of both the alternator and the direct current machines, but with a hand rheostat in series with each, thus allowing a relative adjustment of voltage. The fields of the exciter itself are excited by an outside source through an adjustable rheostat. This complete arrangement gives the necessary large range of adjustments to suit every condition that might arise. The value of this combination machine is, that it allows the use of anodes containing a greater proportion of silver, does away with the necessity of heating the electrolyte and makes a slime containing a less quantity of gold.

The low-voltage dynamos have a graphite composition brush and a device that gives a series of end thrusts on the end of the shaft, which prevents the brushes from wearing tracks in the commutator.

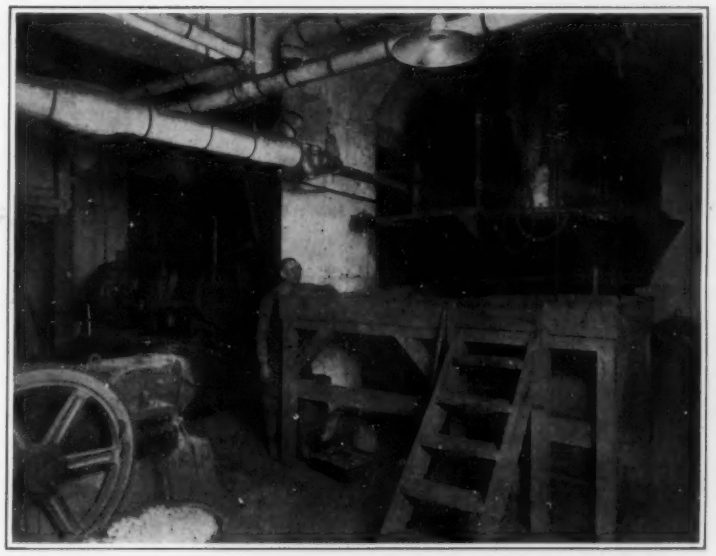
The shop proper contains a lathe, drill press, shaper, emery and grind stone and several smaller machines, all of them operated by individual motors. The rolls for making cathodes are located on this floor and are driven by an alternating current motor. The idea has been to place all possible machines on the sixth floor so that they will be out of acid fumes, and this plan has given all that was expected of it.

The seventh floor has been given over to the silver cells and the precipitating tanks for the foul electrolyte. There are two circuits of vertical cells, each series containing 16 jars placed on a long table built of brick topped with soapstone slabs. The slabs are counter-

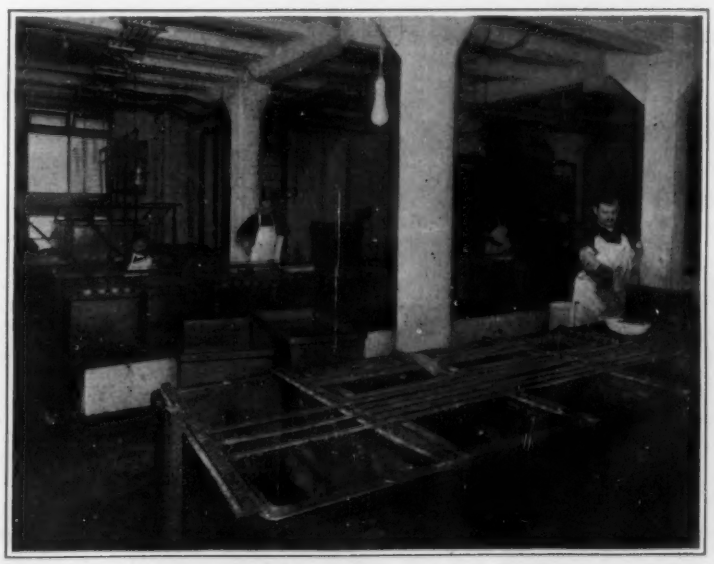
(Concluded on page 153.)



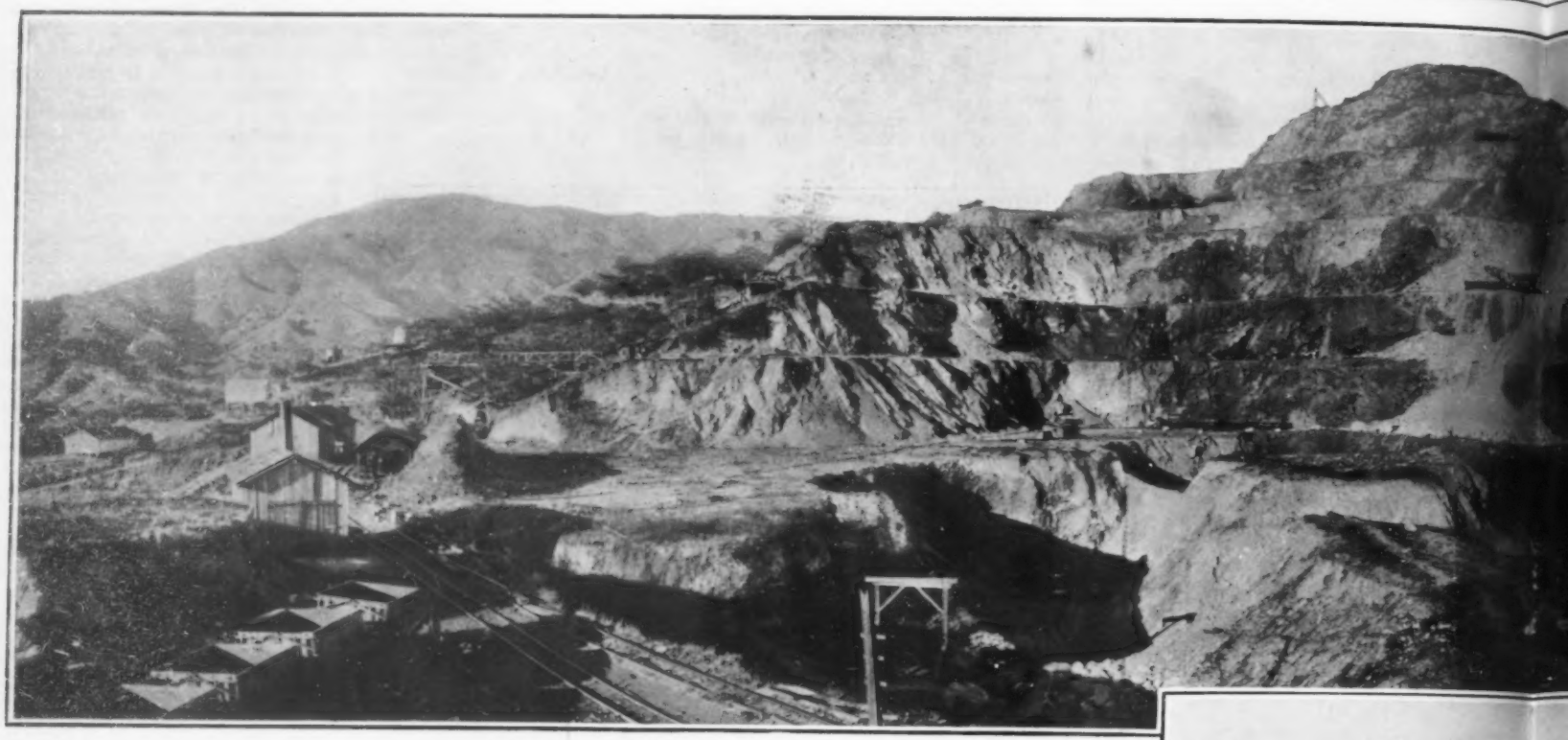
Testing laboratory.



Sweep-handling machinery.



Electrolytic silver-cells.



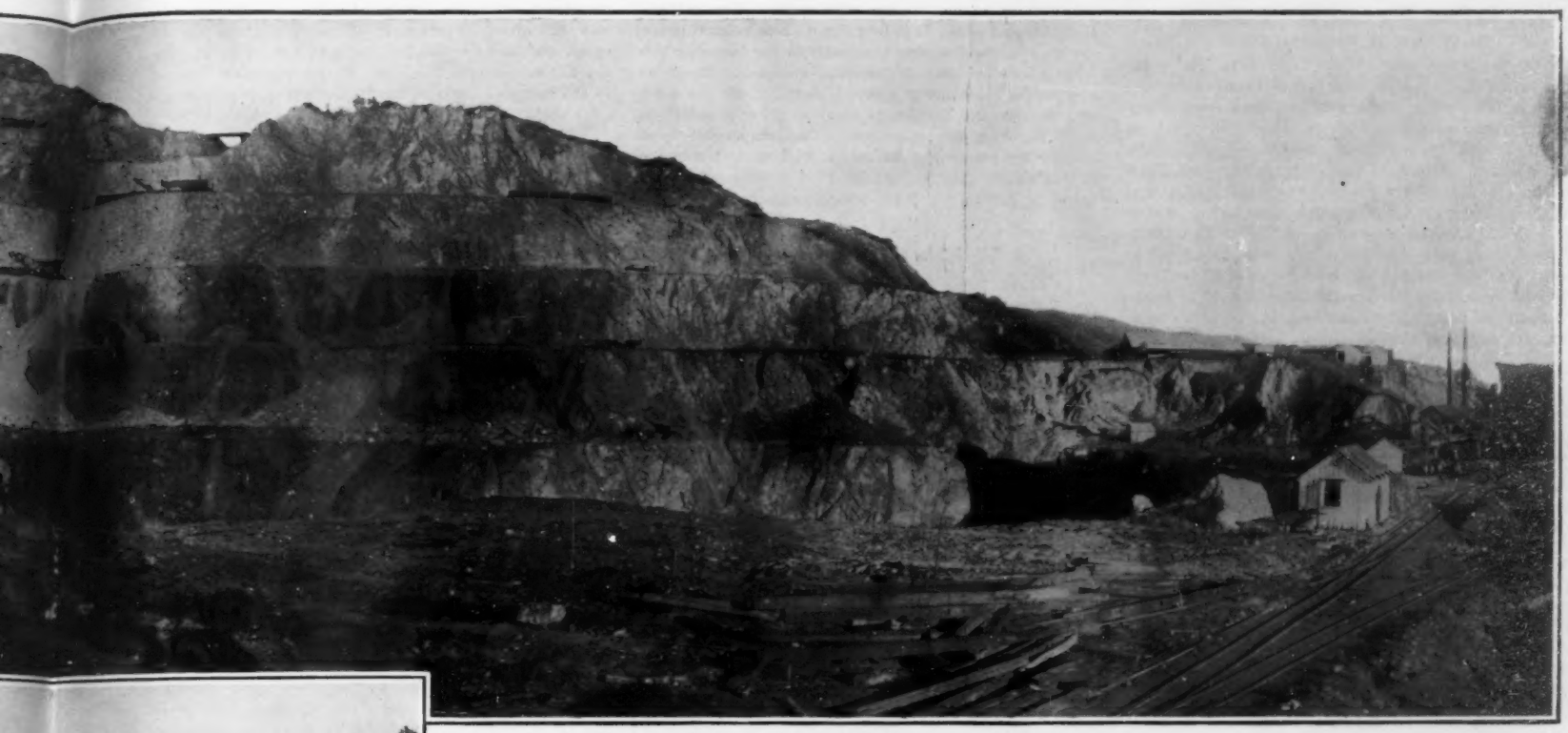
General view of Daiquiri ore strata, showing method of excavation by

Removal of the ore by scraper-bucket excavators.

Gravity line for conveying ore f

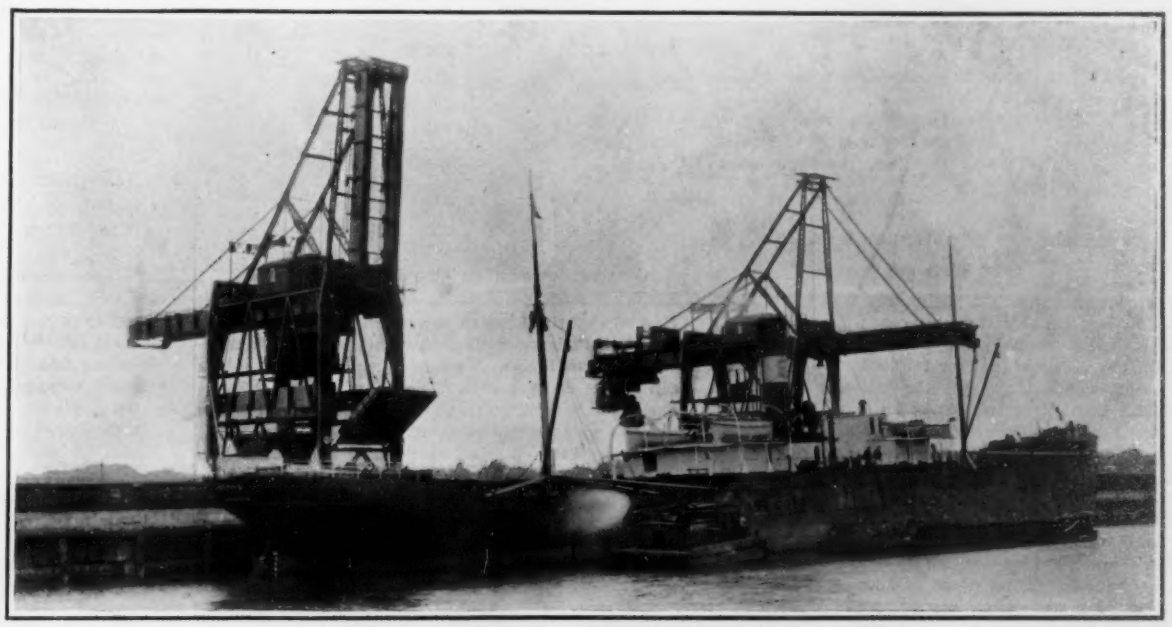
Drag-line excavator at the

THE VAST IRON ORE DEPO



steam shovels. Extent of deposit is shown by depth of excavated strata.

eying ore from mines to tidewater.



Electrical unloader removing Cuban ore from hold of steamship.

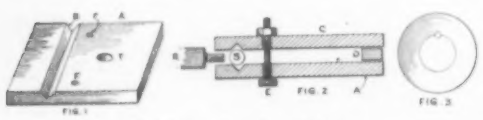
at the Mayari mines.

DEPOSITS OF CUBA.

Cutting Keyways in a Lathe

By William H. Trueman, D.D.S.

THE following method of key-seating by using a lathe as a planer has been found very satisfactory, and with slight modifications, equally satisfactory for cutting slots. A block of wood *A*, say 6 by 12 inches, and about one inch thick, with a groove *B* to hold the shaft, and a hole *T* for tool post, is fitted over the tool post of the slide rest and held firmly by a tool passing through the slot in the post and screwed down upon the block. Two pieces of wood *C*, at each side of the tool post, supported by blocks *D* at one end, the other resting on the shaft, are fastened by bolts *E* passing through holes *F* to clamp the shafts in place. The block is bolstered up so as to bring the center of the shaft opposite the lathe center.



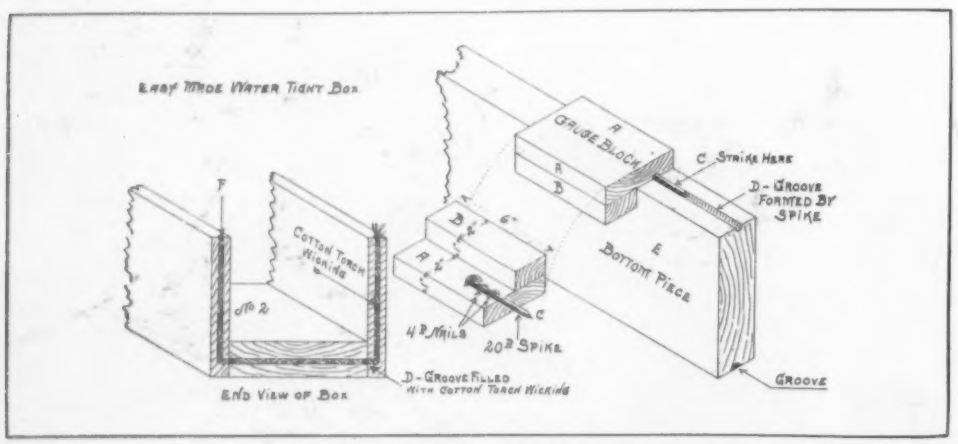
Cutting a key in a lathe.

These adjustments accurately made, a drill of suitable size is used to make a series of holes close together, and in a row as long as the key-seat is intended to be, and nearly as deep. This done, the drill is replaced by an end-cutting reamer *R*. Using the lathe as a milling machine, the key-seat may be neatly and quickly finished. For key-seating the pulley, fit into the bore a metal plug, and with a drill of the same diameter as was the reamer used on the shaft, drill a hole at the junction of the plug and the pulley hub, half of its diameter in each, and finish with a file. To key-seat a pulley at the end of a shaft, simply drill a hole of suitable size at the junction of the shaft and the bore the full length of the hub, and drive into it a tight-fitting round rod. There is an advantage in locating the key-seat directly under the set-screw of the pulley, as by cutting a groove across the key the set-screw will hold the pulley in position lengthwise of the shaft. These suggestions are not original, they are old to many, but may be new to some.

Construction of a Water-tight Box

By W. A. L.

TO make a water-tight box or trough in the ordinary way requires a great deal of care with the joints, but the following method does not call for much skill. Select any soft material for its swelling qualities and to stand close nailing. Fix the bottom piece first by dressing both edges straight and square. Then make a gage block as shown. The gage block *A* is 4 inches wide and *B* is 2 inches wide and both are 6 inches long, made of 1-inch stuff. Fasten the block *B* on one edge of block *A*, with a few light nails, and in the center of one end of block *A* fasten a 20-penny spike as at *C*, with small staples or with small nails driven in half way and bent over the spike to hold it in place. Have the spike project about half its length and drive the head into the wood. Now apply the gage block, as shown in the drawing, to the edge of bottom piece *E*. The spike *C* that projects should lie at about the center of the edge. Now starting at one end of the bottom piece, hammer the spike *C* to form a semi-circular groove *D*. In soft wood it only takes a medium, sure tap of the hammer to make the spike form this groove. Then move the block about 2 inches and strike again, and so on to the end of the piece. The opposite edge should be similarly treated. In the groove thus formed lay a full strand of cotton torch wicking or oakum twisted to a tight strand that will fill the groove, use the gage block to make the groove across the ends, and fasten the cotton wicking in the grooves with tacks. Now prepare the sides and ends. It is best first to bore holes through the sides along the edge that nails to the bottom. Use a bit about the size of the nails, staggering the holes and boring them about 4 inches apart. Nail the sides and ends on and the box is ready to fill with water to swell it; when the water swells the compressed wood around the groove and the cotton wicking, it will make a water-tight joint. This kind of a joint will hold water as well as any made with a combination plane.

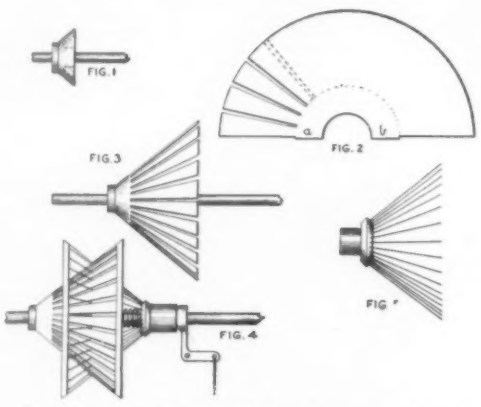


Construction of a water-tight box.

A Variable Speed Groove-pulley

By F. E. Keller

A VARIABLE speed groove-pulley which will convey light power may be made as follows: Turn out a hub as shown in Fig. 1. Then make a cone of heavy sheet iron, laying it out as indicated in Fig. 2. Cut slots in the sheet from the periphery inward, wide enough to receive the wire spokes shown in Fig. 5, placing them as close together as possible and being careful to have the metal strong enough in the center. Then bend the sheet around into a cone with edges *a* and *b* together and rivet it to the flange of the hub, as shown in Fig. 3. Next turn out another hub and fit as many threaded spokes into it as there are slots in the cone, setting them at such an angle as to form a conical row of the same angle as the sheet iron cone.



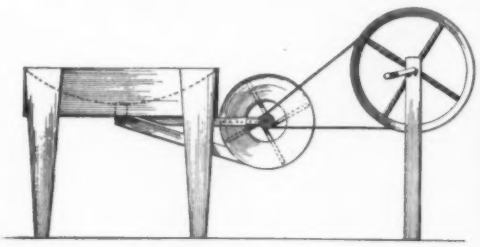
Construction of a variable speed groove-pulley.

Key one of the hubs to the shaft, slip a coil spring in the shaft, bring up the other part, and put them together, as in Fig. 4. To strengthen the pulley a rim can be put on each part. The object of the spring is that when the pulley is wanted larger the spring works the two pulley-members apart and therefore does not injure the belt. Any suitable device may be used to slide them together.

Improvised Forge

By Robert K. Patterson

HAVING an occasion to use a forge where it was not convenient to carry one along, the writer made a very simple one, which would do the work of a factory-made forge, in the following manner: The box of the forge was made of boards. In the bottom of the box a hole two inches in diameter was bored for the air to enter. Then the box was filled in with clay, as shown by the dotted lines in the illustration, to prevent the boards from catching fire. The blower was constructed by nailing four pieces of ½-inch board 5½ by 5-inch to a square wooden center. The case consisted of a large lard can, cut so that it was about one inch wider than the fan. There was about ½-inch clearance between the blades of the fan and the case. In the cover and in the bottom of the can a circular hole was cut about 4 inches in diameter for the air to enter, and another hole in the side 2 by 5 inches for the air to escape. The tube leading from the blower to the box was made of boards having an inside measurement of 2 inches in height by 5 inches in width at the end attached to the blower. The tube was narrowed (so as to compress the air) until it was only 2 inches wide at the box. At the end of the tube a small hinged door was placed which could be opened so that the ashes, which sifted through the tuyere iron, could be blown out. The tuyere iron in this instance was merely a flat piece of iron drilled full of holes. To drive the blower a large grooved wheel was mounted upon two posts and connected by belt to a pulley on the blower. The latter was fastened upon a large spike by flattening a small nail and driving it in between the pulley and a spot on the spike that had been filed flat so as to form a rude keyway. The sharp end of the spike was flattened as much as possible so that it would not turn after it was driven into the wooden center of the fan. Bolted to the bottom of the box were two strips of hardwood about an inch square and about fourteen inches long. To these the blower was bolted. On the end of the strips a small iron strap was fastened, which had a hole drilled in it to act as a hanger for the fan.

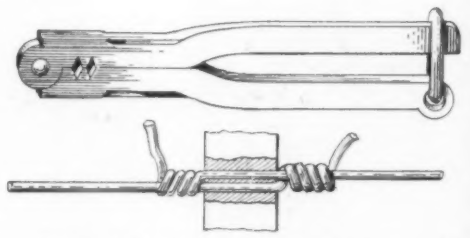


A home-made forge.

Lineman's Clamp from a Buggy Top

By Elbert S. Ramsay

A LINEMAN'S clamp is a handy but costly tool where only a few wires have to be joined. The cut shows one the writer has been using for years and finds it answers every purpose. Take an old buggy top prop iron; one with a good strong joint. Put a repair link in the short arm. Cut off the long arm where the link will just slip over the end. Now with a file cut two notches on the inside of each arm, about three fourths of an inch from the hinge or joint, taking care that the notches will be in register when the clamp arms are brought together and that the rear notch is just a little larger than the forward one with a very thin wall between them. You can splice a No. 8 wire with ease.



Lineman's clamp made out of a buggy top.

Workshop Notes

Finest Emery.—Having need of some very fine emery for grinding an engine valve, and having on hand only the ungraded dust from truing up a fine emery wheel, the following operation was resorted to: A handful of the dust was dropped into the emery box from a height of about two feet. After which a sheet of paper was laid on the box and the finest flour of emery settled slowly down upon it. After treating four handfuls in this way more than enough was obtained for grinding the valve. Of course the operation was performed where there was no wind.—JOE V. ROMIG.

Substitute for a Glass Cutter.—It sometimes happens that when one has to cut glass a glass cutter is not at hand, or the one in use is worn out. The following will make a good substitute. Take an old file, break the end and it will be found that one corner will generally have a very sharp edge, which will cut glass quite as well as any cutter. Of course it soon wears down, but it is merely necessary to break a small piece off the file again and it will be as sharp as before. —EMIL VOGELIN.

Flashlight Signaling for Railways

By Our English Correspondent

IN Sweden a railway flashlight signaling system is being officially subjected to tests with a view to establishing its efficiency in night high-speed travel. It has been used upon private railways since 1908.

The difficulty of the engineer is considerable when traveling at high speed through a busy junction or when entering a terminal outside of which is a maze of signal lights. With a flashing light the express track stands out distinctly and no hesitation is shown in interpreting the signal. It is not advisable to convert all the signals to the flashing system, as a phalanx of flashing lights outside a junction would provoke greater confusion than a similar array of steady lights.

The Dalén flash lamp and mechanism.

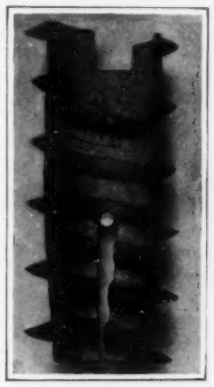
The system is simple and economical. The illuminant employed is dissolved acetylene, stored in small, convenient accumulators placed in a small receptacle at the foot of the post. No alterations in the existing signals or system are required. The flashing apparatus, the ingenious invention of Mr. Gustaf Dalén, M.E., is mounted in the lamp. Flashes of previously determined character are produced so long as the gas supply lasts. The light after once being started requires no attention beyond the replenishment of the reservoir. The system is so economical that the signal is permitted to work both night and day in Sweden, the consumption charges being less than the cost of labor in switching the apparatus into action at dusk and cutting it off at dawn.

Expanding Socket for Screw Spikes

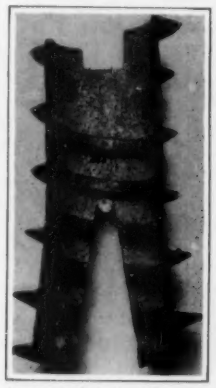
By A. B. Morrison

IN order to provide a better hold for screw spikes in railroad ties, a Parisian engineer has recently invented an expanding socket. The socket consists of a metal tube threaded both within and without. The socket is slit at the lower end to about half its length so as to form four arms which may be spread out by screwing the spike in after the socket has been screwed to the wood. Thus the socket is firmly anchored in the tie and affords a far better grip for the screw spikes than can be obtained by screwing them directly into the wood. At the top of the socket are two diametrically opposed notches which serve, like the slot in a screw-head, to permit of screwing the socket into place. The socket must be placed as close as possible to the edge of the rail base and so the exterior thread is determined by the thickness of the base flange.

As shown in the section, the depth of thread on the inner wall of the socket is not uniform throughout. At the lower part the projection of the thread gradually increases without however changing the pitch. When fitting the sockets into new wood, a hole is first bored to the necessary depth and tapped, after which the top of the expanding socket is fitted with a mandrel and the socket is then screwed home. As the lower part of the socket is slit, the arms will converge, as indicated in one of the sectional views. However, when the screw spike is screwed into the socket the arms will be forced out, as shown, anchoring them firmly into the wood, so that it will be impossible for the socket to be pulled out. In old ties where the screw spikes have been torn out of their holes, or the wood has decayed, it is merely necessary to enlarge the hole, and tap it to fit the expanding socket. Old screw spikes can be replaced in this way right on the track without having to move the rail or the tie.



Socket as threaded into the tie.



As expanded by the screw spike.

As an anchor for the screw spike.

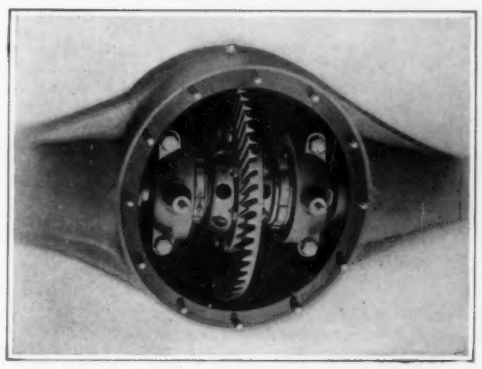
Expanding socket for screw spikes.

A New Noiseless Gear for Motor Cars

FOR almost a year a prominent automobile manufacturing company has been conducting a series of tests and experiments in search for a type of gear that would prove both noiseless and efficient in operation. The result is a worm bevel gear for rear axle drive, to take the place of the straight bevel now so widely employed.

The principal advantages pointed out for the new worm gear are the elimination of backlash and noiselessness of operation. Backlash between two gears results in inefficiency as well as noisy operation. In a set of worm gears the contact between the teeth results in both a rolling and a sliding motion in such a manner that the surfaces are always in contact, while the relative motion between straight bevel or spur gears is principally a rolling one. After a certain amount of wear the spur or bevel gear becomes noisy on account of the backlash. This, however, is claimed to be entirely eliminated in this latest type of gear.

In the accompanying illustration the worm bevel gear is shown installed in the rear axle housing in precisely the same manner as the usual type. Very little difference is noticeable at first glance between this gear and the older one, although on closer inspection it will be seen that the teeth of the worm bevel are curved, as are also those of the pinion which is hidden from view by the differential. With the teeth in this shape it is possible to have one set enmeshing while the set adjoining is becoming disengaged. This affords a more continuous contact and promotes a smooth sliding action between the bevel and the pinion.



A new noiseless bevel gear for motor cars.

Fig. 1.—Record of roll of ship, as traced by gyroscopically-controlled pencils.

Fig. 2.—This gyroscopic device records with great accuracy the roll and pitch of ships at sea.

A Gyroscopic Mechanism for Recording Roll and Pitch of Vessels at Sea

IN a recent paper before the Society of Naval Architects and Marine Engineers, Mr. Elmer A. Sperry mentioned in a more or less casual way, a device which he had invented for recording the rolling and pitching of vessels in a seaway by means of gyroscopic mechanism. The device is so extremely ingenious and efficient for the purpose designed that it is believed to deserve more than the mere mention modestly accorded to it by its inventor.

In attacking the problem of the prevention of rolling and pitching of ships it is evident that we can go at it more intelligently if we are able to determine, in the first place, exactly how much the roll and pitch of various types of vessels is. It is also plain that in order to measure accurately the roll and pitch components proper it is necessary to eliminate as far as possible all motions relating to yawing, azimuth movements and other movements of short periods due to outside influences acting on the ship.

"Universal or compound angular motion may be said to be made up of three primary components similar to the three primary components of white light and probably from the same basal cause; thus universal angular motion may be resolved into motion about three axes, all normal to each other and bearing the relation of the three converging margins of a cube. Gyroscopes mounted for producing motion records, so far as has been heretofore published, are in each case critical to all of the three above named components. In this manner the rolling record is liable to be falsified by motions which really have their origin in yawing, or pitching, or both."

The problem then consists in so mounting a gyroscope as to make it critical to only one single component of motion and at the same time to make it have such a very long natural period as to be entirely removed from any influences of the comparatively short periods of motion on the ship itself.

This the inventor has succeeded in doing in the apparatus shown in Figs. 1 and 2, and by means of a set of ingeniously mounted pencils we are able to record the curves of rolling and pitching for any vessel with a high degree of accuracy. The recorders shown consist essentially of two sets of gyroscopic pendulums, one for recording the roll, and the other for recording the pitch, and to give the reader a concrete idea of the qualities of the pendulums it may be stated that they actually represent (due to their high speed of rotation) a weight of 1½ tons hung from a point 10 miles above the earth, thus having a practically infinite period of oscillation. It is by means of this very long virtual length of pendulum that there has been eliminated in the records practically all influences of extraneous motion except that of the one selected component of the motions of the ship, such for example, as the rolling or the pitching.

As may be seen from inspecting the photograph, the equipment consists of two sets of gyro wheels, two wheels in a set, about twenty pounds in weight, mounted within a case performing the function at once of a support for the wheels and the precession ring. These wheels are electrically driven by a 3-phase motor mounted within the frame of the machine so as to give to the wheels practically the same speed.

The wheels of either set spin in opposite directions and further, precess oppositely, the precession frames being coupled for opposite and neutralized precession. There is seen mounted in the lower part of the frame a motor generator set which receives 125 volts direct current and delivers 3-phase alternating current. A low electric motive force is used on the A. C. side so that all points of the apparatus will be harmless from this cause.

The spinning gyro wheels are mounted in elliptical stabilized rings supporting the gyro cases on parallel axes, and these in turn are pivoted at right angles to the main frame of the apparatus. The stabilized base frames are seen to be normal to each other, one responding to all the components of the pitch of the ship and the other to the roll of the ship, and they are prac-

(Concluded on page 153.)

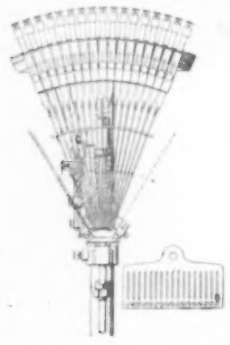
RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

HAIR PIN.—H. JACOBSEN, 2023½ Market St., Galveston, Tex. The object here is to provide means on the hairpin itself which will automatically engage a portion of the hair and grip the same, so as to secure the hairpin in position on the hair without danger of getting lost.

BUTTONHOLE MARKER FOR SHOES.—E. T. ADAMS, Portsmouth, Ohio. The present device is an improvement over that shown in Mr. Adams' prior patent No. 1,026,484. In the first patent a series of marking points were simultaneously actuated so as to mark the position of the buttonholes at one operation. The present device has a similar arrangement and means for simultaneously adjusting the relative positions of the marking



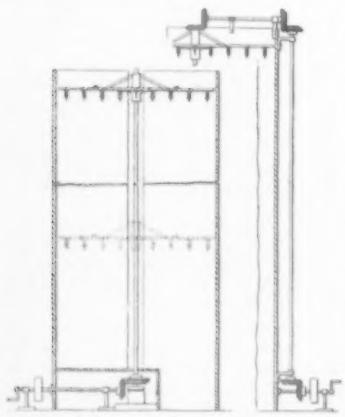
BUTTONHOLE MARKER FOR SHOES.

devices in the direction of the line of buttonholes. This consists of a movable spreading device which causes a lateral movement of the marking devices. Means provide for actuating the spreading device and for locking it in position; also an anvil for each marking point with means for holding the anvil during the operation of the marking point.

Of Interest to Farmers.

CORN HUSKER.—G. L. MILLER, Geneseo, Ill. Address Charles G. Davis, lawyer, Limb Building, Geneseo, Ill. The object here is to provide a hand device which may be easily attached to and detached from the hand of the user, and by means of which the husk may be readily torn from the ear, without injury to the hand or strain thereon.

FEED DELIVERY ATTACHMENT FOR SILOS.—S. M. SCOTT, Edna, Tex. The present invention relates to Silos, particularly to an attachment whereby the ensilage may be

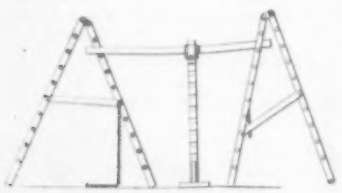


FEED DELIVERY ATTACHMENT FOR SILOS.

delivered therefrom as it is desired for use without necessitating the climbing of the silo and entrance thereinto for this purpose.

Of General Interest.

SCAFFOLD LADDER.—C. G. BISHOP, Southampton, N. Y. An object here is to arrange improved means adapted to be variously adjusted and rearranged for accomplishing a plurality of purposes, all of which relate to the use of scaffolding of various kinds. Further, to provide a scaffolding device formed



SCAFFOLD LADDER.

of two members connected by a pivotal link and carrying braces for holding the supporting members a proper distance apart and locking the same in that position. The scaffolding ladder is associated with intermediate supports designed to support scaffolding bars. The ladder proper may be used in various capacities as a support for scaffolding, as an ordinary ladder, and as a scaffolding support for use on roofs of various shapes.

VAGINAL SPECULUM.—L. DROSIN, Manhattan, N. Y., N. Y. This instrument combines in a single, reliable, efficient device the functions of previous ones, with the result that not only may an operation be more quickly and easily performed, but a surgeon acting alone is enabled to perform operations which now commonly demand the co-operation of one or more assistants and with avoidance of pain.

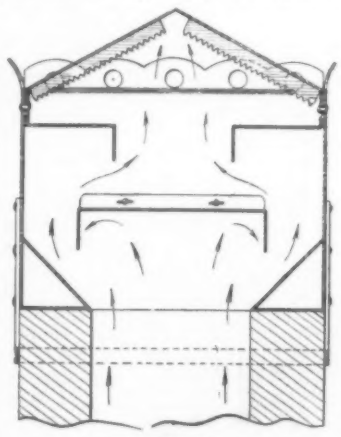
PORTABLE AND STATIONARY WIRE FENCE CONSTRUCTION.—C. D. BENNETT, Scipio, Ind. The intention here is to provide a cheap, durable, efficient, and easily constructed portable or stationary fence, and a further object is to provide a means for bracing the posts in position, both in the plane of the fence and at an angle thereto.

SAFETY SHOPPING BAG.—W. M. FISH, 34 E. 14th St., Manhattan, N. Y., N. Y. The invention refers to shopping bags and the like adapted to be carried in the hand or on the arm and has particular reference to a means whereby such a device may be rendered practically safe from being opened surreptitiously while being so carried.

OVERHEAD SWITCH AND AUTOMATIC TROLLEY STOP.—W. ROTHE, 114 E. 91st St., Manhattan, N. Y., N. Y. This stop is for overhead railways or switches of the type used in slaughter houses and similar places where the article being carried is suspended from a suitable carriage, and the object of the inventor is to provide a structure which will automatically be set when the switch is open, and which will automatically move out of the way when the switch is closed.

GREENHOUSE GLAZING.—F. VAN ASSCHE, Fulton and Rose Aves., Jersey City, N. J. The object here is to provide an inexpensive and efficient glazing, in which the roof formed by the panes of glass is smooth between the sash bars receiving the glass, and in which the panes of glass can be replaced without disturbance to the panes lying between the same sash bars.

CHIMNEY CAP.—J. E. MCCALL, Montgomery, Ala. The particular purpose here is to provide a cap having a comparatively simple form and provided with means for facilitating the escape of smoke and hot gases, while preventing the wind from blowing downwardly into the chimney, and yet allowing the escape of water falling in the form of rain upon the top of the cap. Provision is made for arresting and returning a portion of the soot, sparks, and analogous matter, so that such matter is, as far as possible, prevented from escaping from the chimney. Also means are provided for trapping and holding such materials as are carried upward with smoke and hot gases passing through the chimney for further combustion.



CHIMNEY CAP.

CAMERA ATTACHMENT.—C. O. HARPER, 110 Chestnut St., Louisville, Ky. The more particular purpose of this invention is to enable a camera to be adjusted for taking pictures of different sizes, the size of the picture being controlled by the amount of film surface exposed, and this being adjustable at will within reasonable limitations.

FOLDING UMBRELLA.—C. P. CARRINGTON, R. L. and T. SESEMIHL, care of last, 1796 Fulton St., Brooklyn, N. Y. The invention refers to umbrellas and more particularly to so-called folding umbrellas, that is to say, umbrellas so constructed that the sticks may be shortened for the purpose of shortening the umbrella so that it may be carried in a suit case.

MOLD FOR CEMENT POSTS.—D. R. HOBBS, 1411 W. 14th St., Oklahoma, Okla. The inventor has devised a molding appartus which, save a base-board, may be immediately removed from the freshly molded post without waiting for the material to harden to any considerable degree. Thus he is able to mold posts rapidly, so that they may be produced at comparatively small cost.

EVAPORATING APPARATUS.—D. COZZOLINO, P. O. Box 465, Escondido, Cal. The invention relates to apparatus for dealcoholizing, condensing, evaporating or distilling liquids that foam during ebullition, and its object is to provide an evaporating apparatus arranged to reduce foaming of the liquid to a minimum while undergoing ebullition and thus preventing the liquid from passing out of the apparatus.

SWINGING PIPE JOINT.—W. KIRKWOOD, 309 E. 17th St., Pittsburg, Kan. The improvement is in swinging pipe joints, and the purpose is the provision of a simple device, especially adapted for use in making a flexible connection between two pipe lines, without the use of hose or connections of fabric materials.

CUSPIDOR COLLECTOR AND CARRIER.—W. A. NIELSON, 546 W. 124th St., New York, N. Y. The purpose here is to provide a cuspidor collector and carrier for use in office buildings, hotels and other places, and arranged to permit of readily collecting a number of cuspidors and safely carrying the same to a distant place for washing and other purposes.

VACUUM CLEANING APPARATUS.—E. B. DUNN and A. F. DUNN, 10 Hanothorne Place, E. Orange, N. J. In this case the purpose of the invention is to provide a new and improved vacuum cleaning apparatus, arranged to automatically insure a continuous operation with a view to draw in the dust from the house line, to slime the same and to discharge the slimed dust.

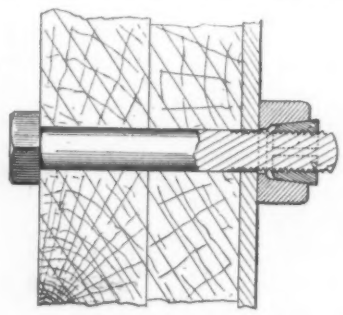
Hardware and Tools.

TOOL HOLDER.—H. CURTIN, care of Dr. Charles E. Pannaci, 51 Tremont St., Gloversville, N. Y. This invention relates to lathes, and its object is to provide a new and improved tool holder arranged to readily accommodate different forms and sizes of turning, forming or boring tools, and to permit of securely fastening the desired tool in place.

RULE.—H. GASSTROM, care of Dahl Manufacturing Company, 417 Fifth Ave., Manhattan, N. Y., N. Y. The intention here is to provide an extensible rule made up of a plurality of sections movable longitudinally of one another, there being suitable means enabling the sections of the rule to be held in position for measurement in closed or extended position.

PIPE VISE.—T. PEARSON, 414 Midland Ave., Syracuse, N. Y. This invention relates to a bench vise for gripping pipe of that type used by plumbers, pipe fitters and the like, and wherein the upper or sliding jaw is attached to the operating screw by a swiveled connection. The principal object is to improve the swiveled connection between the operating screw and the movable jaw.

NUT LOCK.—I. R. HICKS, Hallsville, Mo. In the present patent the invention has reference to nut locks, the more particular purpose of the improvement being the provision of a simple and strong construction of nut lock in which the locking mechanism is not



NUT LOCK.

only self-tightening, but in case of the belt stretching slightly, the parts will automatically assume their relative positions, thereby enabling the locking mechanism to obtain a new grip. The engraving shows a longitudinal section through a bolt provided with the improved nut lock.

FASTENER.—F. M. STURGES, 12 Cleveland St., Danbury, Conn. The object of this invention is to provide a new and improved fastener for use on tire chains, logging chains, hame

FASTENER ON CHAINS, HAMES, ETC.

fasteners and similar devices, and arranged to take up all slack in a flexible connection, to securely fasten the parts together and to relieve the pivot of the connecting link of undue strain.

Heating and Lighting.

FURNACE DOOR OR DAMPER.—J. B. PHILLIPS and J. A. KAPLAN, Zanesville, Ohio. Address the former, 523 Avington Ave. This invention provides the heat-resisting surface of the door or damper and preferably consists of a unitary slab or refractory material of the nature of firebrick. The construction does away with all metallic members where the device is subjected to destructive heat, and results in substantially an all-refractory damper; as to the exposed portions, the metallic members being confined to simple hanger devices and connections, so arranged as not to be subjected to destructive heat.

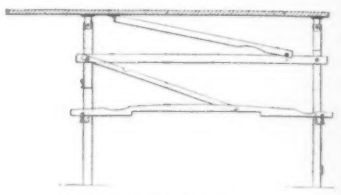
FURNACE.—J. B. HODAPP, Mankato, Minn. The improvement relates more particularly to that class of furnaces built of independent sections. It provides a furnace of interchangeable parts having a relatively large heating space in proportion to the amount of water subjected to the heat. Means provide for regulating the volume of fire in the fire box, and also an automatic regulator for the parts.

Household Utilities.

BED.—T. H. SORLIEN, Granite Falls, Minn. The purpose of the present invention is to provide a false ceiling part which is adapted to occupy the opening in the ceiling when the bed is in use and to remain at that time in a position flush with the ceiling in order to conceal the opening.

CLOTHES DRIER.—P. D. RIORDAN, 1273 Lexington Ave., New York, N. Y. The present patent further develops the principles of the former patent granted to Mr. Riordan in providing an easily portable and ornamental apparatus for drying clothes, or daily airing them after use, with marked economy of time and space, since for given height the present drier can carry twice as much clothes as a similar one that cannot be completely revolved upon its axis as this one can be.

FOLDING TABLE.—J. S. SIMONTON, 1015 Pine St., Hood River, Ore. The invention relates more particularly to a combined folding and convertible table, one that may be folded and unfolded and when in the latter position may be adjusted to the ordinary height there-



FOLDING TABLE.

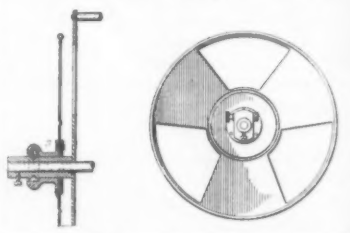
by to form a lap-board. It provides a table capable of performing functions such as outlined, the folding and adjustment of which may be easily and readily accomplished and which will be strong, durable and comparatively inexpensive.

WORK BENCH.—J. P. MACKAY, 149 E. 127th St., New York, N. Y. This inventor by substituting a metal arm and wedge for a regular vise, is enabled to produce an effective household portable work-bench consisting of but two pieces, top and side. Light, powerful and practical, it is adapted for use wherever a regular bench is not available and is capable of being rigidly clamped in a wide variety of situations while occupyinig a minimum of space when not in use. It is advertised in the classified ad. column.

Machines and Mechanical Devices.

PAPER GUIDE.—ALICE U. DAVIS, 416 Caples Bldg., El Paso, Tex. The present invention relates to improvements in construction of paper guides as disclosed in a patent of the U. S. numbered 1,040,901, granted to Alice U. Davis. The principal object of the present invention is to provide means whereby the guide may be folded when not in service position, to permit covering the typewriting machine to which said guide is attached, in the usual manner.

SHUTTER FOR MOVING PICTURE MACHINES.—W. P. MCILVANIE and W. S. QUINBY, Bellingham, Wash. The invention is an improvement in shutters for moving picture machines, and has for its object the provision of a simple, easily operated device for



SHUTTER FOR MOVING PICTURE MACHINE.

adjusting the shutter, which may be applied to existing machines without other change than removing the shutter. The improvement may be used with any machine of the character in question, and without any change in the machine, except the removal of the old shutter.

ADVERTISING MEANS.—G. T. FIELDING, 575 Pelham Ave., New York, N. Y. The inventor provides a means for use in show windows and other places, and more especially designed for advertising effervescent drinks and

the like by displaying the representation of a person in the act of drinking an effervescent drink, such as soda, from a glass. The mechanism is completely hidden from the onlooker.

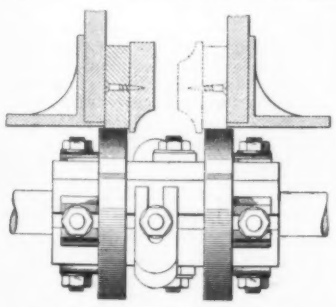
AUTOMATIC FELT TIGHTENER FOR PAPER MAKING MACHINES.—F. B. HOOKER and W. J. TREMPE, St. Johnsburg, Vt. Address O. V. Hooker & Sons, same place. The present patent provides an improved device over that disclosed in No. 934,857, fomerly granted to W. J. Trempe, and it consists in certain changes in mechanism which renders the device less liable to bind. This invention provides a device using less tension weights than the older form, and one more durable. It takes the place of the rack and gear mechanism of the older device which was found to clog with dirt and oil.

MAIL POUCH FASTENER.—J. L. SMITH, 718 E. Cache la Poudre St., Colorado Springs, Colo. The intention here is to provide means permanently secured to the mail pouch, and so constructed and arranged that the tee strap may be caused to encircle the gathered neck of the pouch and the fastening means quickly snapped together without any tedious manipulation thereof.

PUMP.—G. DORFFEL, 2316 E. 27th St., Oakland, Cal. The object of the present invention is to provide a new and improved pump structure designed to utilize air as the motive power, and to be automatically operated thereby continuously as long as the water is permitted to flow.

SUBMARINE MINE.—G. E. ELIA, Hotel de Crillon, Place de la Concorde, Paris, France. This submarine mine is of the kinds that are adapted to be anchored to the bottom of the sea. According to the invention the mine is so constructed that it is caused to explode by the rotary movement of the same effected by a ship passing the mine in contact with the same. This is obtained by the mine being provided with a swinging arm or the like extending laterally from the mine, which arm strikes the ship during the said rotary movement of the mine.

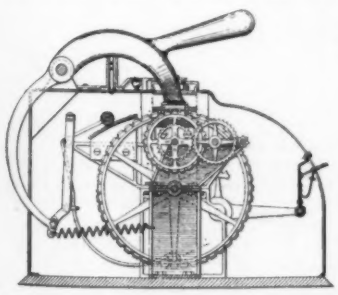
SHAPER.—R. S. LA RUE, 306 E. Sandusky St., Bellefontaine, Ohio. This invention relates particularly to shaping rings designed to be used with the cutting head of a planing or other similar machine, and has for an object the provision of a structure which will cause



SHAPER FOR PLANING MACHINE.

the cutting or planing knives to follow a certain shape or form. It provides a pair of guiding rings on a cutting head so as to guide various shaped forms as the same pass over the cutting head whereby the knives may shape an article according to the forms used.

STAMPING MACHINE.—J. W. TERRY, 321 Augusta St., San Antonio, Texas. This machine is more especially designed for use in



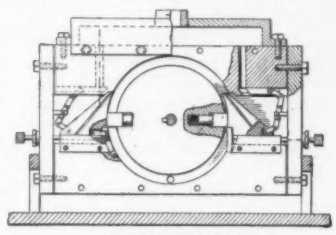
STAMPING MACHINE FOR RAILROAD TICKETS, ETC.

railroad ticket offices for accurately stamping railroad tickets on their faces with the date of issue, the destination and the time limit or number of the train on which the ticket is to be used.

Prime Movers and Their Accessories.

AXIAL THRUST COMPENSATOR FOR TURBINE.—H. FÖTTINGER, 4 Prutzstrasse, Stettin, Germany. In accordance with the present invention the thrust of the steam or gas upon the rotor of the motor turbine is utilized for compensating wholly or partly for the axial hydraulic thrust of hydraulic transmission gears connected with the motor turbine and *vice versa*. This arrangement renders it possible either wholly or in part with the usual pressure compensating means such as pressure plates, labyrinth pistons or thrust bearings, both in the steam turbine and in the hydraulic transmission gear or at least to limit their number considerably.

ROTARY ENGINE.—G. W. SNEAD, Ringgold, La. Mr. Snead's invention relates to rotary engines, his more particular purpose being to provide an engine of this type with im-

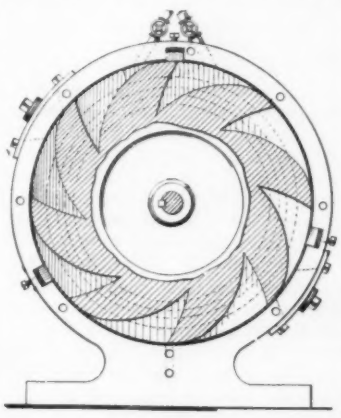


ROTARY ENGINE.

proved reversing mechanism and with sliding abutments of special form and controlled, together with movable guides coacting therewith, and also with reversing valves to reverse the engine by practically a single manual movement.

IGNITER FOR INTERNAL COMBUSTION ENGINES.—H. REICHE, Millstone, N. J. The invention relates to certain improvements in that type of igniter in which a small quantity of the explosive mixture is compressed in an auxiliary cylinder to such a pressure that it automatically ignites and serves for the ignition of the main charge in the working cylinder.

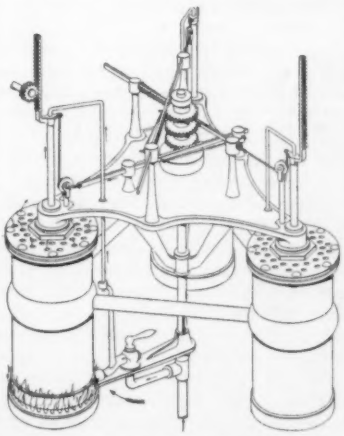
ROTARY ENGINE.—S. BENNISON, deceased; Meta Bennison, executrix, 1828 Ave. N, Galveston, Tex. The purpose here is to provide a rotary engine or pump having rings for engaging the sides of the wheel near its periphery, to prevent the fluid under pressure from escaping toward the axis of the wheel, so that its full power may be exerted on the impact faces



ROTARY ENGINE.

of the buckets spaced apart on the piston wheel between the sides which are engaged by the packing rings. The engine casing is provided with cocks for indicating any escape of the fluid in the direction of the axis of the wheels, so that, when necessary, the packing rings may be adjusted to prevent further escape of the fluid.

FLUID EXPANSION ENGINE.—J. I. FORTOUL, deceased; Luisa A. B. de Fortoul, trustee, care of Julian A. Arroyo, 82 Wall St., N. Y., N. Y. This invention relates to an expansion engine of general application, and more particularly it relates to that form of heat engine which depends upon the expansion of a fluid as its actuating medium. The key-

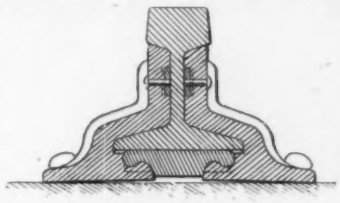


FLUID EXPANSION ENGINE.

note of the Fortoul thermo-motor is simplicity. The cost of operation and maintenance is low and the first cost is intended to compare very favorably with any type of engine on the market. Its clean and noiseless operation indicates an ideal power producer, and the impossibility of explosion. The use of the principle in this case is not confined to the production of power, but has many other uses applicable to the arts of to-day.

Railways and Their Accessories.

RAIL JOINT.—J. E. FOOTE, 516 E. 8th St., Topeka, Kan. This invention enables contraction of the rail on the general direction of the length thereof to tighten the joint; enables the weight of the rail and downward pressure of spikes associated with the rail to tighten the joint; provides means for preventing separa-

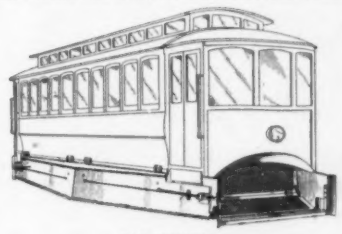


RAIL JOINT.

tion of various parts comprising the rail joint, and generally to render the joint as far as practicable self-tightening; avoids use of bolts and analogous fastening members except in instances where desirable to use the same; and improves the general efficiency of the rail joint.

STREET RAILWAY SWITCH.—A. V. WORTHINGTON, 1389 64th Ave., Oakland, Cal. In the present patent the invention has reference to a switch in which manually-controlled means on the car serve to engage devices located in the track to throw the switch element in either direction so as to close or to open the switch.

CAR FENDER.—G. MELLINO, 309 Vanderbilt St., New York, N. Y. This invention provides a fender, the operation of which insures the lifting of a body from the ground when directly in front of the vehicle to which the fender is applied; provides means whereby the body is deflected laterally from the path of said vehicle and away from the carrying wheels



CAR FENDER.

thereof; provides means for accommodating members to roadbed inequalities; provides an emergency, for closing the gap between the roadbed and the body of deflector; and provides means automatically operable for placing the fender in lowered position and for closing the gap between the side deflectors and the roadbed.

CAR REPLACER.—W. H. WARD, 11½ Green St., Cumberland, Md. The design in this instance is to provide a car replacer comprising separate blocks or guides for the wheels, adapted to be located alongside the rails, in which provision is made for causing the wheels to be inevitably guided to the rails when running upon the slopes or inclines of the replacer.

RAILWAY SAFETY APPARATUS.—J. D. NIX, Ferriday, La. Address National Railway Safety Appliance Co., Room 19 Masonic Temple Bldg., New Orleans, La. An object here is to provide an apparatus to be installed on locomotives for automatically shutting off steam, setting the brakes and sounding an alarm when another train is within the same block. This apparatus comprises a solenoid or magnet, the action of which is effected by circuit connections through a similar apparatus on two locomotives in the same block, said magnets effecting the movement of certain valves so as to permit entrance of steam for effecting the operations mentioned.

Pertaining to Recreation.

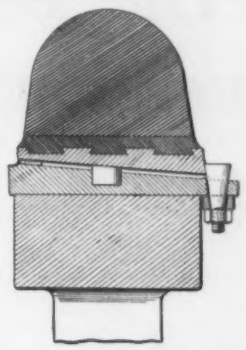
DETONATING DEVICE.—S. J. HIBON, care of Asher Kleinman, 250 Eighth St., Manhattan, N. Y., N. Y. This device is for amusement purposes, and the object of the invention is to provide a construction in which all danger in the use thereof is eliminated. If the caps are dropped anywhere and walked on, no accidents result. It can be used also as an alarm device instead of firearm in case someone should need to summon help in the night time.

ARTIFICIAL FISH BAIT.—C. W. LANE, Madrid, N. Y. The invention is an artificial minnow having side or pectoral fins adapted to be oscillated vertically so as to simulate the natural minnow, the oscillation being effected by suitable connections of the fins with a longitudinal shaft having a tail spinner which is rotated by friction with the water as the minnow is drawn through the latter.

Pertaining to Vehicles.

WAGON BRAKE.—C. SMITH, 408 West First St., Duluth, Minn. The present invention has reference to wagon brakes, and more particularly to a brake mechanism especially adapted to spring wagons, the object being to provide a simple, strong, and effective mechanism for the purpose mentioned.

DEMOUNTABLE RIM.—W. J. LANE, Youngstown, Ohio. This invention relates to demountable rims, and refers particularly to the class comprising a fixed and removable rim



DEMOUNTABLE RIM.

mutually engaged and means for keeping the same in predetermined position and affording an easy and rapid separation of the same. An object is to provide an inexpensive and reliable rim that can be easily mounted and removed from a vehicle wheel.

VEHICLE WHEEL.—J. W. CALTA, Platte, S. D. An object of this invention is to provide a wheel in which the necessary resiliency is secured by means of a number of springs, these springs taking the place of the ordinary pneumatic tire and having similar functions to it. A series of springs is provided, the ends of which bear rollers, thereby eliminating friction and adding to the efficiency of the device.

PORTABLE BATTERY SUPPORT.—M. KOENIG, 550 First Ave., L. I. City, New York, N. Y. This support is to be temporarily applied to the frame of a chassis of an electric automobile, whereby the several batteries may be withdrawn from their normal support for inspection or repair and then easily replaced, whereby the difficulty usually experienced in removing the batteries from the chassis upon trucks or otherwise for conveyance to a distant point is overcome.

Designs.

DESIGN FOR A HOLY WATER FONT.—T. LLOYD, 40 Northfield St., Boston, Mass. In this ornamental design of a holy water font the front view presents the Saviour on the cross with appropriate symbols and inscription, and the rear presents the Virgin centered in a multi-pointed design. The form of the font is high and somewhat narrow, the whole producing a very beautiful effect.

DESIGN FOR A MONUMENT.—F. J. DAVIS, care of Davis Bros., West Berlin, Vt. In this ornamental design the monument inside elevation presents an inverted T form, while the perspective view shows a broad thick square on a base, the front having a circle for inscription and bordered with ornamental designs.

DESIGN FOR A DUSTING CAP.—J. TWINEM, 220 Ashford St., Brooklyn, N. Y. In this ornamental design for a dusting cap the article is shown in front and rear perspective views. The cap is of round form with a scalloped edge ornamental piece extending nearly around the cap and producing a plain, though exceedingly pleasing composition.

DESIGN FOR A BUST REDUCER BRASSIÈRE.—MARIE PERILLAT, care of Lady's Outfitterie, 15 W. 38th St., Manhattan, N. Y., N. Y. This ornamental design, No. 44,411, is shown in a perspective view as seen from the front and a similar view from the rear.

DESIGN FOR A CUT-GLASS DISH.—F. H. SMITH, 151 West St., Greenpoint, Brooklyn, N. Y. In this ornamental design the dish is circular. A horse shoe surrounded with leaves and the words "Good Luck" within the shoe, occupy the center of the dish.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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The Ten Greatest Inventions of Our Time

We hear much of the great inventions of the past—the telegraph, the sewing machine, the telephone, the reaping machine, photography, Bessemer and open hearth steel, the steam engine and the phonograph. Yet the inventions of our own time are as epoch-making and as dramatic as these.

Perhaps because we have become accustomed to the use of the old machines and discoveries, perhaps because the achievements of latter-day inventors succeed one another so rapidly that we are not given much time to marvel at any one of them, we have not fully realized how stirring and wonderful are the products of modern ingenuity.

Only five years ago the man-carrying aeroplane made its first public flights; only the other day hundreds of passengers on a sinking ship were saved with the aid of wireless telegraphy. At least a dozen inventions as great have been perfected in our own time, and all of them have made a man's work count for more than it ever did before, and have made the world more livable than it ever was.

Why should we not tell the story of our own deeds?

Why should we not review the industries created by men who are still living, men whose names will go down into history with those of Watt, Morse, McCormick and Howe?

Tha was the underlying idea of the November Magazine Number of the Scientific American. We knew that the "ten greatest inventions of our time" was a big subject when first we planned the number, but how big it was we never realized until we surveyed the field of modern invention.

Then we saw how astonishing was the progress made in our own day, how much mankind had benefited by the inventions of great modern intellects. We began to appraise inventions, to weigh one against the other, and to determine in our own minds which ten had contributed most to human progress and happiness, which were really great pioneer inventions, and which merely remarkable and valuable improvements on successful past conceptions. There were so many achievements to consider that it was hard to arrive at a definite conclusion.

The upshot of our own thinking has been to leave to our readers the decision

What Are the Ten Greatest Inventions of Our Time, and Why?

For the Three best articles on the subject, the Scientific American offers in the order of merit, three cash prizes:

First Prize: $150.00 for the best article
Second Prize: $100.00 for the second best article
Third Prize: $50.00 for the third best article

Write for the Conditions of the Contest.

Teaching from the Child's Point of View

(Concluded from page 141.)

not add to our knowledge, though he is facile in new combinations, and in any case, only that man can be original who can cut himself loose from current associations. He says that there are the systematizers and critics, predominantly synthetic and analytic, respectively, but the highest degree of intelligence possesses great power in both synthesis and analysis.

In his study in connection with the intelligence of over 800 pupils Meumann found that not infrequently very bright school children show a slow immediate reproduction, whereas less intelligent pupils exhibit a quick and fitful reproduction, showing less capacity of mental effort, and indicating less attention to the content, together with a tendency toward less resistance in reproduction.

He concludes that wealth of imagery and originality of reproduction, without, however, any departure of the subject from the type proper to his stage of the development, are characteristics of intelligence. Dull pupils reproduce, e. g., words frequently named together, and depend much on what has been learned at school for the material as well as the form of reproduction; their imagery is not so concrete as that of the bright child. Dull pupils also use verbal imagery to a larger extent than bright pupils, thus tending to approximate to the adult type of thinking and consequently appearing in this regard precocious. His results show that the degree of mental development of pupils is ascertained by their capacity of abstraction, and can be recognized by their retention of abstract words, since such retention is mainly dependent upon their ability of understanding the words. He asserts that the positive relation between memory and general mental proficiency of pupils is very striking.

On the basis of the present writer's experiments in the Zürich laboratory Meumann speaks very critically of the popular notion that the child's memory is superior to that of the adult, because these experiments show that the child needs more time and more repetitions in memorizing than the adult. Thus, an adult needed 10 repetitions to memorize a series of 12 nonsense syllables, and a school child needed 63 repetitions to memorize the same series. Of course, there is a falling off after maturity in the capacity to learn new and disconnected facts, but this inability must not be taken as a characteristic of anything except the commencement of the disabilities of age.

A Scientific Study of Children.

In his tests of the memory of school children alone and when working together he found that the class-room disturbing influences (the noise of writing, walking about, whispering, the sight of the movements of the pupils, the occasional words of the teacher, etc.) have no special influence, i. e., the pupil shows better results if he works together with other pupils in the school than if he works alone, isolated. These differences in memory for the individual and the common test were strikingly large in cases of the younger children. One day he asked a number of the pupils in case of the individual tests whether they would prefer such exercise in the class or alone; 80 per cent of the pupils gave the decided answer that they would prefer to do the work in the class-room. In one other experiment he tested repeatedly a few 13- or 14-year-old-pupils with the dynamometer and his ergograph, and found that in the case of the tests of the pupils separately, with no one else in the room, the quantity of work was always less than when the others were present.

In many other of his investigations of the pupils he found great and interesting individual differences. But he does not want to push the doctrine of individual differences in pupils to the extreme, because we should thus make a science of education impossible, for science cannot account for the individual; a science of

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MUNN & CO., INC.

Inquiry No. 9310. Wanted addresses of manufacturers of good selling articles for mail order business catering to the trade of agents.

Inquiry No. 9311. Wanted names and addresses of manufacturers of hatpin heads made of colored glass; also medals of all shapes.

Inquiry No. 9312. Wanted to buy a machine which will pick up a weight the size of a lima bean by vacuum process. Must be able to pick up dust, gravel, etc. Must be operated by electricity and be easily portable.

Inquiry No. 9313. Wanted to buy Leather Held Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from $5,000 to $10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Inquiry No. 9316. Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

Inquiry No. 9317. Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvass.

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Inquiry No. 9320. Wanted an article suitable for large manufacturing—plant equipped for making Boats, Marine Engines, etc. The plant would be capable of making almost any article. A large wood-working establishment is also operated in connection with the metal shops.

Inquiry No. 9321. Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the tins and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

education gives pedagogical principles as principles, i. e., as fundamental rules, and as such they must be impractical, for it is only when the rule is applied that we have something practical. Meumann claims that what we want now from a science of education is to know not so much the minute differences between individual normal pupils as what is true generally. In his investigations of individual differences among pupils he found special types of learners in each branch of work, and a knowledge of such types is more important for class teaching than that of minute individual differences. When means have been devised to determine these individual differences and certain uniformities we shall be able to classify, grade and promote pupils scientifically, and not divide them according to ages or sizes or school marks, as has been suggested and practised, as more satisfactory. Experimental pedagogy would also enable us to know what are the limits set by innate conditions to the work of education, and even to the selection of a trade or profession and work of life itself. Chancellor E. E. Brown rightly said recently that the practical dictum of this new pedagogy is that every large community needs a "clinic" where parents and teachers may receive advice on school matters, a "consulting engineer" in educational affairs.

Buying and Selling Silver and Gold

(*Concluded from page 145.*)

sunk, making a ½-inch rim around the whole table, thus preventing drops of the electrolytes from falling on the floor. The floor of this room, and the eighth, or gold, room is made of soapstone slabs, so that any spill of acid or electrolyte does no harm. A centrifugal hand rubber pump lifts the foul electrolyte from the level of the cells to that of the precipitating tanks and for this purpose is much superior to the reciprocating type, as there are no valves under which small pieces of foreign matter may lodge, interfering with the proper action of the machine.

The eighth floor contains the gold cells, which, with the exception of the sweep cellar, completes the plant. The gold cells are set on soapstone topped tables. There are two tables, each holding two sets of twelve cells, with a heavy soapstone dividing slab through the middle. On the top of the dividing slab, electrically driven, runs a light shaft line with pulleys at proper intervals. The propellers are carried on wooden arms bolted to the central slab and are driven by a light belt from the shaft line. In cleaning up, the entire top of the cell is exposed, thus giving the man in charge ample space for lifting out anodes and slimes. A large soapstone hood with wire reinforced glass for sides, gives the proper facilities for the treatment of platinum and palladium solutions.

A testing laboratory is partitioned off from this floor, in which all the foul solutions are tested for values before they pass to the sewer. The different electrolytes are tested for their strength of acid and metal values and also any necessary experimental work done.

The sweep cellar has been put in operation recently and its equipment consists of a jaw crusher which crushes the sweeps to one inch or less in diameter, one mill with 60 mesh screen which grinds the sweeps under water until they are fine enough to pass through the screen to the two settling tanks, and a steam drier. The type of mill is a standard mining machine where the rolls revolve and the pan remains stationary. It is of sufficient size so that it will not be necessary to keep the mill in continuous operation, and the men will be available in other places.

The drier constantly agitates the wet sweeps so that they cannot bake on the bottom. One settling tank is directly above the other and the lower contains a steam syphon which lifts the water to the upper. From the upper tank there is an overflow to the sewer and a connection which leads the water back to the mill so that it may be used over again.

A Gyroscopic Mechanism for Recording Roll and Pitch of Vessels at Sea

(*Concluded from page 149.*)

tically free from response to all other components of motion.

The rolling and pitching records are made upon two rolls of paper six inches in width driven by the same small motor at the same rate. There is also provided a means of marking the seconds on the record, and the center or base line from which it can be determined to which side any particular roll was made. The level of the records is about four feet from the base of the machine and the entire equipment is self-contained and portable.

Some idea of the extreme accuracy of the apparatus can be obtained from the following report of a test: The vessel on which the machine was mounted was floated in the bottom of a dry-dock, the water being drained down to 18 feet. The weather conditions were excellent, with practically no wind, and the vessel was almost entirely protected from any outside influences by the sides of the dock. There were used three plumb bobs on lines 12½ feet long, the bobs being submerged, and the movement of the pencil was constantly checked up by the lines. The vessel was under constant motion and every motion was perfectly apparent and could be easily recorded. Whenever the boat settled to an extremely small fraction of a degree of roll, the center was determined with great accuracy and it was found that at no time had the gyroscopic pendulum of the apparatus moved a hair's breadth. This was further corroborated by the position of the levels connected with the pendulum. Interest, of course, centered upon the return of the datum point at the end of the test, and it was found that the pendulum returned to within less than 1/64 of an inch of its original position. It was first thought that this was an error of the apparatus, but upon comparing results it was found that the vessel itself had not come back to within ⅛ of an inch of the bob lines, which exactly checked with the reading of the gyroscopic recorder.

Large List of Prizes in 1914 Rubber Exhibit

THE fourth International Rubber and Allied Industries Exhibition, in conjunction with the first International Cotton, Fibers and Other Tropical Products and Allied Industries Exhibition, is to be held in London from June 24th to July 9th, 1914. The object of the exhibit, like that of its predecessors, is to promote trade and commerce with all rubber-producing and consuming countries, as well as to bring together producers, manufacturers, chemists, scientists and dealers in rubber products both crude and manufactured. The exhibition will permit of the display of the principal commercial products of rubber grown in the soil, as well as manufactured products, machinery, and appliances. Many of the British and foreign governments and associations have already expressed their willingness to being represented in the various departments.

One of the most important features of the announcement is the offer of a large number of prizes to exhibitors in the different departments. The committee of the Rubber Growers' Association will conduct a series of six contests, offering prizes as follows: First, medals for the best commercial samples of crepe, smoked sheet and assorted grades of plantation rubber; second, a gold medal for the best exhibit connected with plantation rubber grown in the middle East; third, a prize of £50 ($250) and a gold medal for the most valuable improvement connected with the collection or preparation of plantation rubber; fourth, gold, silver and bronze medals for the three best exhibits of manufactured rubber flooring in tile or sheet form; fifth, a gold medal for the exhibit composed of the greatest variety of articles made from rubber for commercial purposes; sixth, £50 ($250) and a gold medal for the most valuable discov-

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CAN you find it? Don't try. Let George do it—George Fitch. He's an expert at it—author of "The 4:11 Train." Catch it in the September number of THE AMERICAN MAGAZINE. It will take you back to a "Homeburg" of your own, and you'll live over again that delicious moment when the world rolls into your town once a day. Most trains are "wasted," but the 4:11—well, it's a real train.

Also in September is "Lucky Baldwin," guilty of every crime in the calendar, and "Lucky" because he never wore a stripe. Can a *down-and-out* "come back"? Peter Clark Macfarlane says, "YES!"—and "Lucky Baldwin" bears him out. The answer is inspiring. It is the first of a series of splendidly human papers on "Those Who Have Come Back." Read it, if you know what it is to *fail*. Read it, if you would learn what it is to struggle against yourself—and *win*.

David Grayson is in the September number, and Walter Prichard Eaton; also Hugh Fullerton (at the bat), James Montgomery Flagg, Stephen Leacock and "Angel Island." And, by the way, that Train! Don't miss it—*it's the 4:11*—round trip, 15 cents—any news-stand—the September number of

The American Magazine

The Scientific American Handbook of Travel

With Hints for the Ocean Voyage, for European Tours, and a Practical Guide to London and Paris
By ALBERT A. HOPKINS, *Editor of the Scientific American Reference Book*

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ery and application for a new use for plantation rubber.

In another contest a first prize of 75 guineas ($384.00) and a second of 25 guineas ($128.00) are offered for new ideas for the use of plantation rubber. Sir Henry A. Blake, president of the exhibition, will present a trophy for the exhibit proving of greatest interest in connection with the production, preparation or use of rubber in any form. The *India Rubber World* is offering a handsome silver cup 50 inches in height for the wild rubber competition, and the *India Rubber Journal* is presenting a cash prize of £25 ($125) for the best plan of an ideal rubber estate factory. Among the several other prizes offered are those for exhibits of tropical products, samples of rubber, cotton, essays on the ideal rubber estate, and two prizes for the best hand and power spraying machines.

Further particulars regarding the exhibits and prizes may be obtained on application to the International Rubber and Allied Trades Exhibition, Ltd., 75 Chancery Lane, London, W. C.

NEW BOOKS, ETC.

EXPERIMENTAL WIRELESS STATIONS. Their Theory, Design, Construction and Operation. By Philip E. Edelman. Minneapolis, Minn.; Philip E. Edelman. 12mo.; 224 pp.; illustrated. Price, $2 net.

The author somewhat resents the name "amateur" as applied to him who pursues some branch of practical science as a hobby or spare-time occupation. "Amateur" or "experimenter," his book is written especially for this genus, and furnishes much information regarding sharply-tuned modern installations which comply with the new law. The experimenter's rights are defined in almost tabular conciseness. Only a very limited knowledge of electricity and mathematics is necessary to the reader in order for him to profit by the suggestions of the handbook.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES FOR BUYERS AND SELLERS. Especially Devoted to the Architectural, Engineering, Electrical, Mechanical, Railroad, Iron and Steel, and Kindred Industries. New York: S. E. Hendricks Company, 1913. 4to.; 1666 pp. Price, $10.

The advent of a new edition of Hendricks' Commercial Register is a timely event for all those who have occasion to deal with manufacturers, and to those who are purchasers of supplies. This invaluable book is in constant use in the SCIENTIFIC AMERICAN office, six copies of which are required to answer the many queries of our subscribers and in our various departments. It is a never-failing source of accurate information referred to by those in almost every line of business. Extreme care is taken to keep this book absolutely up-to-date, and in its use we have demonstrated that it is exceedingly accurate. The book should be in the hands of every business concern. Some idea of its scope can be obtained by the annexed statement of the publishers:

The aim of Hendricks' Commercial Register is to furnish complete classified lists of manufacturers for the benefit of those who want to buy and sell. The total number of classifications in the new Register is over 55,000; each classification represents the manufacturers or dealers in some machine, tool, specialty or material. The present is by far the most complete edition published. The twenty-first annual edition required 122 pages to index its contents, while the twenty-second annual edition requires 138 pages, or 16 additional pages. As there are upward of 400 classifications on each page, the 16 additional pages of index represent the manufacturers of over 6,000 articles, none of which have appeared in any previous edition. The twenty-first annual edition numbered 1,546 text pages, while the twenty-second annual edition numbers 1,635, or 89 additional pages. Add to the latter about 348 pages of cancellations, errors, etc., omitted from the edition, and there is a total of 437 pages of new matter, the whole representing upward of 390,000 names and addresses.

THE CLIMATE AND WEATHER OF SAN DIEGO, CALIFORNIA. Prepared under the Direction of Willis L. Moore, Chief United States Weather Bureau, by Ford A. Carpenter, Local Forecaster. Published by the San Diego Chamber of Commerce, 1913. 12mo.; 118 pp.; illustrated with photographs and charts.

In a most attractive booklet replete with cloud-pictures of distinct artistic and scientific value, the author records many facts relating to the climatic conditions of San Diego. San Diego winters are warm, yet there is less than one hour per year when the mercury registers above 90 degrees. The characteristic "velo" cloud is given credit for this condition in a very interesting chapter. The study is continued through chapters on humidity, fog, and the rainy season. The forecasting of San Diego weather, and how the weather map is made, is the subject of another condensed chapter, and there is an explanation of meteorological instruments and their uses.

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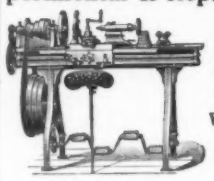

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(12840) P. B. writes: I notice that the universal explanation of the apparent increase in size of sun and moon as they approach the western horizon is still this, in brief: That when these bodies are nearly passing from view, we have objects near the horizon with which angular comparison is consciously or unconsciously made. I do not believe that this is the proper explanation, or rather not the one of prime importance. First, because, if a screen is held up so as to shut off the view of these objects, it does not make the heavenly bodies seem smaller. Second, because the phenomenon can be explained on the principle of the magnifying glass, the air being the medium by which the light is refracted, and the observer being on the inside of the refracting medium. To understand the view, just suppose an insect to be placed on the inside of a convex lens and to view an object outside the lens; would not the object appear larger? (In this illustration the lens and insect should, for convenience, be considered quite small.) It will be unnecessary, in this connection, to mention that sunlight and moonlight pass through the air at a greater distance when the sun and moon are low than when they are high, and other well-understood facts, as, for instance, that the refraction will be greater when the sun and moon are viewed from the zone which the light reaches after passing through the atmosphere in a nearly horizontal direction. A. We find ourselves unable to adopt your view of the cause for the enlarged appearance of the sun and moon upon the horizon, and must still hold to the theory that this is an optical illusion, caused by the intervention of objects with which we unconsciously compare them. If you will look with one eye at the moon through a pasteboard or paper tube, say an inch in diameter and 12 to 18 inches long, so as to shut out a view of all other objects on the horizon, closing the other eye, and then opening and closing the eyes alternately, with a little practice you should have no difficulty in seeing the moon shrink and swell in size, being seen smaller through the tube and larger with the other eye. This experiment, which is very old, is taken to demonstrate that this is an optical illusion, due to intervening objects. We would point out that refraction does affect the sun on the horizon, but so as slightly to flatten it vertically, so that it presents an oval appearance, and not an enlarged appearance. Finally, we may point out that the sky itself is affected in the same way as the sun and moon. A degree on the horizon seems larger. Two stars seem farther apart at or near their rising than when high overhead. With a sextant these appearances disappear. The moon measures a half degree on the horizon. Indeed, it measures somewhat more when high in the sky, since it is then nearer to us by the radius of the earth, or about a sixtieth of its distance from us. This is discussed at length in Todd's "New Astronomy," pages 240 and 241, which we send for $1.45 postpaid.

12841) LeR. A. M. asks: Is mean or sidereal time used in astronomical calculations, such as light years, etc.? A. Sidereal time is the time of the astronomer. If he needs to do so, he transforms his result to mean solar time. The year is a solar event, and not sidereal. The Sidereal Year is the time required for the sun to go from a given star around to the same star again. In mean solar time this is 365.25636 days. The year of the equinoxes, called the Tropical Year, because of precession, is 365.24219 days. The Sidereal Year is used in calculating the Light Year, since this is the real or true year. See Young's "Manual of Astronomy," Sect. 547. We send the book postpaid for $2.50.

(12842) W. C. G. asks: Does an electro-magnet repel aluminium instead of attracting, as iron is attracted by it? If repelled, is the force of repulsion equal to that of attraction where the same weight of aluminium and iron are acted upon by the same electro-magnet? That is to say, would an electro-magnet repel an ounce of aluminium with the same amount of power as it would exert in attracting an ounce of soft iron? If aluminium is not repelled by an electro-magnet, what metals are? A. A very powerful electro-magnet would exert a very slight repulsive force upon aluminium, but the repulsive force would not equal the attractive force upon the same weight of iron at the same distance. Bismuth is the metal which is most powerfully repelled by a magnet, but no metal is repelled with anything like the attractive force upon iron by the same magnet.

(12843) C. S. asks: In the SCIENTIFIC AMERICAN or the SUPPLEMENT within the last few years is an article on various fluids placed in tanks for removing the heat of light beams passing through projection apparatus. Not knowing how it is indexed, I cannot find the article. Will you favor me with the page and volume? A. There is nothing better than clear water for removing the heat from the beam of light in the projecting lantern. A tank of water is placed in front of the condenser, and as often as it gets hot, should be emptied and filled anew.

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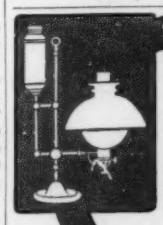

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